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Safety Belt Use in Michigan Immediately Prior to the Labor Day Mobilization, 2004

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16. Abstract

This study reports the results of a baseline survey conducted in August 2004, immediately prior to a safety belt mobilization. A follow-up survey conducted around the Labor Day holiday will provide comparison data and will be discussed in a separate report. Together, these survey waves will provide an assessment of the Labor Day Safety Belt Mobilization efforts. The survey was 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). Additional analyses were conducted to determine the belt use rates by several demographic, environmental, and vehicle characteristics. Statewide safety belt use was estimated at 88.3 percent in the current survey. This belt use rate represents the highest statewide level of belt use ever observed in Michigan. While higher belt use was found in nearly all demographic categories, the historical “low belt use groups” continue to lag behind others. The study results suggest that Michigan should continue to design and implement campaigns to raise the safety belt use rate, particularly using the “Click It or Ticket” model coupled with safety belt enforcement zones. Historical low belt use groups should continue to be a focus of these efforts.

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CONTENTS

LIST OF FIGURES

LIST OF TABLES

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INTRODUCTION

In March 2000, when the enforcement provision of Michigan's safety belt law was changed from secondary to primary (standard) enforcement, an increase in safety belt use from 70.1 percent to 83.5 percent was observed (Eby & Vivoda, 2001). Around the same time, the "Click It or Ticket" (CIOT) slogan was adopted in Michigan as the public face of a new law enforcement strategy designed to maintain and further increase the belt use rate. This slogan was adopted in Michigan based upon the results of several focus groups consisting of the people that tend to wear safety belts less often than others: pickup truck drivers, young men, and African Americans (National Highway Traffic Safety Administration, NHTSA, 2002). Of the messages tested, these groups overwhelmingly identified the CIOT message as the most effective (NHTSA, 2002). Throughout the next several years, all Michigan Office of Highway Safety Planning (OHSP)-funded safety belt enforcement conducted throughout the state took place under the CIOT name (NHTSA, 2002).

As mentioned earlier, belt use was quite high immediately following the enforcement provision change. However, as time passed, the rate dropped somewhat, as is typically observed when a new law is implemented or changed, but generally remained about 10 percentage points higher than the pre-change level. A new concerted effort was then made to continue to increase Michigan's belt use. While these efforts were successful at times, the belt use rate seemed to fluctuate between about 80 and 84 percent, but could never quite break through the 84 percent plateau. During safety belt mobilizations conducted between 2000 and 2003, the rate would increase, but as time passed the rate would revert back to around 80 percent.

In June 2003, as part of a new safety belt use mobilization, Michigan's belt use rate reached an all time high of 83.9 percent. During this new mobilization, OHSP redoubled its efforts to strengthen the enforcement and media components of CIOT. A new tagline for CIOT to emphasize the enforcement aspect of the campaign "Buckle Up or Pay Up" was implemented. 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. 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 addition to the heavy enforcement effort, Michigan also conducted a series of media events throughout the state to announce the safety belt campaign, including radio, television, and cable advertising.

Given the initial success of the enforcement zone pilot test, this same model was implemented and expanded for the next several mobilization efforts. During the most recent mobilization, conducted around Memorial Day 2004, officers in 48 different counties wrote more than 34,000 citations in about 700 enforcement zones (OHSP, 2004a). This effort resulted in a belt use rate of 86.8 percent, again an all time high (Eby & Vivoda, 2004). The continued efforts during safety belt mobilizations, with the addition of safety belt enforcement zones, have been successful in raising the belt use rate in Michigan above the previous plateau.

The goal for Michigan’s belt use continues to be 90 percent in 2004. To reach this goal, OHSP received additional federal funds to implement a mobilization effort surrounding the 2004 Labor Day holiday (OHSP, 2004b). As part of this effort, nearly 150 law enforcement agencies in 31 counties conducted safety belt enforcement zones (OHSP, 2004c). The current survey was conducted prior to the beginning of the mobilization and was designed to provide baseline safety belt use information. A follow-up survey, conducted during and after the mobilization efforts will provide comparison safety belt information.

METHODS

Sample Design

The sample design for the present survey was closely based upon the one used by Streff, Eby, Molnar, Joksch, and Wallace (1993). While the entire sampling procedure is presented in the previous report, it is repeated here for completeness, with modifications noted.

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 population of Michigan 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 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 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,

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

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 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.

[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.

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/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.

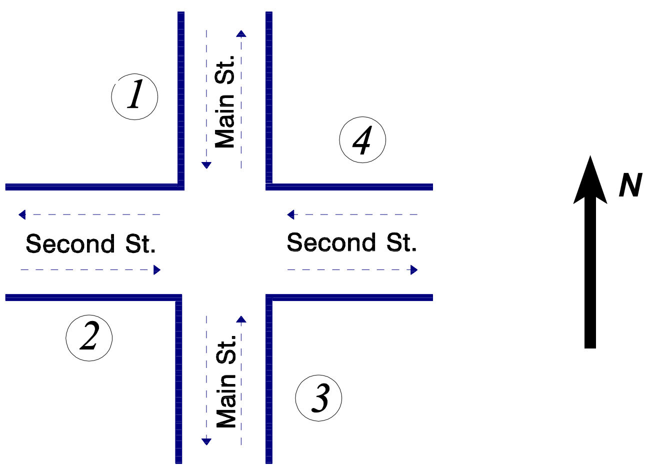

Figure 1. An Example "+" Intersection Showing 4 Possible Observer Locations.

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 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.

[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.

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 a 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

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

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. As shown in this table, the observations were fairly well distributed over day of week and time of day. 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, with a very small percentage conducted during rainy weather. No observations were conducted during snow.

Table 2. Descriptive Statistics for the 168 Observation Sites

Day of Week		Observation Period		Site Choice		Weather	
Monday	13.7%	7-9 a.m.	10.7%	Primary	98.8%	Sunny	55.4%
Tuesday	13.1%	9-11 a.m.	19.7%	Alternate	1.2%	Cloudy	44.0%
Wednesday	11.3%	11-1 p.m.	16.7%			Rain	0.6%
Thursday	16.7%	1-3 p.m.	23.2%			Snow	0.0%
Friday	17.2%	3-5 p.m.	20.8%				
Saturday	14.3%	5-7 p.m.	8.9%				
Sunday	13.7%						
TOTALS	100%		100%		100%		100%

Data Collection

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

Data Collection Forms

Data were collected during the survey using personal digital assistants (PDAs). For a more detailed description of the PDA data collection process, see Appendix C. Two electronic forms were developed for data collection: a site description form and an observation form. For each site surveyed, separate electronic copies of the site description form and observation form were created in advance. The site description form allowed observers to provide descriptive information including the site location, site type (freeway exit ramp or intersection), site choice (primary or alternate), observer name, 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 electronically sketch the intersection and to identify observation location. Finally, a comments section was available 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 electronic form, the observation form, was used to record safety belt use, passenger information, and vehicle information. For each vehicle surveyed, shoulder belt use, sex, and estimated age of the driver and the front-outboard passenger were recorded along with vehicle type. Children riding in child restraint devices (CRDs) 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 belted in the analysis. Based upon NHTSA (1999) guidelines, the observer also collected data from commercial vehicles, and noted this in the electronic form. 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.

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 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 one-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 vehicles in the lane immediately adjacent to the curb, 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. 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 A 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 of vehicle occupants. 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 telephone calls to report progress and discuss problems encountered in the field, e-mails to the field supervisor from each observer's PDA containing data from the preceding day, text messages to the observer's PDAs to alert them to any important information, and visits to the UMTRI office to deliver expense forms and timesheets. 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 files 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. 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) were noted.

Data Processing and Estimation Procedures

The accuracy of electronic data was verified by checking for inconsistent codes (e.g., the observation end time occurring before the start time; "no passenger" marked, when passenger data were present) and missing data. Any errors noted during this process were corrected.

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

[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.

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:

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

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 83 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 0.83 during the averaging to correct for its lower total VMT. The overall belt use rate was determined by the following formula:

$$r_{all} = \frac{r_1 + r_2 + r_3 + (0.83 \times r_4)}{3.83}$$

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 B 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 a full statewide direct observation survey wave. This wave was conducted to determine baseline safety belt use prior to a safety belt mobilization campaign conducted around the Labor Day holiday, 2004. The annual statewide survey wave, conducted during and after the mobilization, will serve as a follow up wave to measure any changes related to the mobilization and will provide a comparison point for historical trends in belt use. The results from the annual survey will be discussed in a separate report.

Overall Safety Belt Use

As shown in Figure 2, 88.3 percent ± 0.9 percent of all front-outboard occupants traveling in either passenger cars, sport-utility vehicles, vans/minivans, or pickup trucks in Michigan between August 5 and August 18, 2004 were restrained with shoulder belts. 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 between 87.4 percent and 89.2 percent. To date, the current belt use rate of 88.3 percent, is the highest statewide belt use rate ever observed in Michigan.

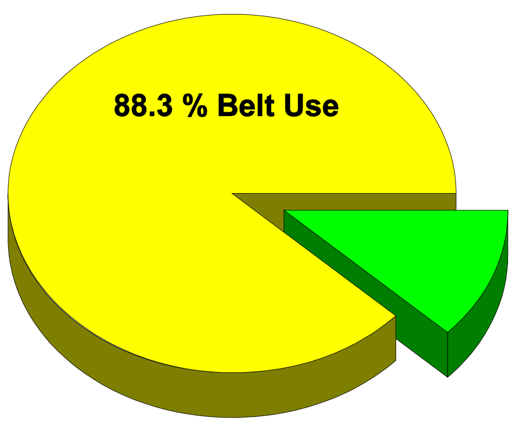

Figure 2. Front-Outboard Shoulder Belt Use in Michigan (All Vehicle Types and Commercial/Noncommercial Combined).

Estimated belt use rates and unweighted numbers of occupants (N) by stratum are shown in Table 3. Safety belt use was the highest in Stratum 1, followed closely by Stratum 2; this difference was not statistically significant. Belt use was slightly lower in Stratum 3 and lower still in Stratum 4. The observed difference between Stratum 1 and 3 was significant, while the difference between Stratum 2 and 3 was not. The belt use observed within Stratum 4 was significantly lower than all other strata except for Stratum 3.

Table 3. Percent Shoulder Belt Use by Stratum (All Vehicle Types)

	Percent Use	**Unweighted N**
Stratum 1	91.1 ± 1.3	4,009
Stratum 2	90.3 ± 1.5	2,241
Stratum 3	86.7 ± 2.1	1,819
Stratum 4	84.7 ± 2.5	4,299
STATE OF MICHIGAN	**88.3 ± 0.9 %**	12,368

Estimated belt use rates and unweighted numbers of occupants by stratum and vehicle type are shown in Tables 4a through 4d. For occupants of passenger cars, sport-utility vehicles, and vans/minivans, belt use differences by stratum generally followed the same trends described for all vehicle types combined. For pickup truck occupants, there were very few differences in belt use among the strata. When comparing across vehicle types, there was no significant belt use difference between occupants of passenger cars, sport-utility vehicles, and vans/minivans. However, the overall belt use rate of 82.1 ± 2.0 percent for pickup truck occupants was significantly lower than for any other vehicle type (Table 4d). This finding is consistent with results from previous surveys (e.g., Eby & Vivoda, 2001; Eby, Vivoda, & Spradlin, 2003; Vivoda & Eby, 2002). Thus, enforcement and PI&E programs should continue to target pickup truck occupants.

Table 4a. Percent Shoulder Belt Use by Stratum (Passenger Cars)		
	Percent Use	Unweighted N
Stratum 1	92.5	1,992
Stratum 2	92.7	963
Stratum 3	88.6	885
Stratum 4	86.1	2,374
STATE OF MICHIGAN	**90.1 ± 1.3 %**	6,214

Table 4b. Percent Shoulder Belt Use by Stratum (Sport-Utility Vehicles)		
	Percent Use	Unweighted N
Stratum 1	93.7	792
Stratum 2	91.3	445
Stratum 3	87.6	301
Stratum 4	86.1	770
STATE OF MICHIGAN	**89.9 ± 1.5 %**	2,308

Table 4c. Percent Shoulder Belt Use by Stratum (Vans/Minivans)		
	Percent Use	Unweighted N
Stratum 1	90.2	604
Stratum 2	90.6	337
Stratum 3	85.2	266
Stratum 4	82.4	569
STATE OF MICHIGAN	**87.3 ± 2.0 %**	1,776

Table 4d. Percent Shoulder Belt Use by Stratum (Pickup Trucks)		
	Percent Use	Unweighted N
Stratum 1	83.5	621
Stratum 2	83.2	496
Stratum 3	81.6	367
Stratum 4	80.0	586
STATE OF MICHIGAN	**82.1 ± 2.0 %**	2,070

Safety Belt Use by Subgroup

Site Type. Estimated safety belt use by type of site is presented in Table 5 as a function of vehicle type and for all vehicles combined. As is typically found in safety belt use surveys in Michigan (Eby, Molnar, & Olk, 2000; Eby, Vivoda, & Fordyce, 2002), use was higher for occupants in vehicles leaving limited access roadways (exit ramps) than for occupants in vehicles traveling on surface streets. This effect was consistent across all vehicle types.

Time of Day. Estimated safety belt use by time of day, vehicle type, and all vehicles combined is shown in Table 5. Note that these data were collected only during daylight hours. For all vehicles combined, belt use was generally highest during the morning and evening rush hours. Within the different vehicle types, the highest level of belt use was also generally observed during either the morning or evening commute.

Day of Week. Estimated safety belt use by day of week, vehicle type, and all vehicles combined is shown in Table 5. Note that the survey was conducted over a 3-week period. Belt use clearly varied from day to day, but no systematic differences were evident.

Weather. Estimated belt use by prevailing weather conditions, vehicle type, and all vehicles combined is shown in Table 5. There was essentially no difference in belt use observed during sunny or cloudy weather conditions. Since observations during rainy weather conditions occurred at less than one percent of the sites, comparisons of safety belt use by this weather condition are not meaningful.

Sex. Estimated safety belt use by occupant sex, type of vehicle, and all vehicles combined is shown in Table 5. Estimated safety belt use is higher for females than for males in all four vehicle types studied, and for all vehicle types combined. Similar results have been found in every Michigan safety belt survey conducted by UMTRI (see, e.g., Eby, Molnar, & Olk, 2000; Eby, Vivoda, & Fordyce, 2002). The largest difference between the sexes (of nearly 10 percentage points) was noted among those traveling in pickup trucks.

Age. Estimated safety belt use by age, vehicle type, and for all vehicle types combined is shown in Table 5. As there were only three 0-to-3 year olds observed in the current study, the estimated safety belt use rate for this age group is not meaningful. Safety belt use for all vehicles combined is highest for the 60-and-over age group and the 4-to-15-year-old age group. However, the results for the 4-to-15 year old age group should be interpreted with caution since the unweighted N of this group was also quite small. These groups were followed by the 30-to-59-year-old group, with the lowest belt use found among those 16-to-29 years old. These results are consistent with previous UMTRI safety belt studies (see, e.g., Eby, Molnar, & Olk, 2000; Eby, Vivoda, & Fordyce, 2002), and show that new drivers and young drivers (16-to-29 years of age) should continue to be a focus of safety belt use messages and programs.

Seating Position. Estimated safety belt use by position in vehicle, vehicle type, and all vehicles combined is shown in Table 5. This table shows that for all vehicle types combined, safety belt use for both drivers and passengers is essentially the same. This trend is also generally noted within the different vehicle types, with only very small differences between the seating positions.

Table 5. Percent Shoulder Belt Use and Unweighted N by Vehicle Type and Subgroup	All Vehicles		Passenger Car		Sport-Utility Vehicle		Van/Minivan		Pickup Truck	
	Percent Use	N	Percent Use	N	Percent Use	N	Percent Use	N	Percent Use	N
Site Type										
Intersection	87.4	8,163	89.6	4,035	89.2	1,537	84.7	1,169	81.8	1,422
Exit Ramp	89.3	4,205	90.5	2,179	91.3	771	88.9	607	83.7	648
Time of Day										
7 - 9 a.m.	90.4	1,142	93.1	569	82.1	228	91.3	155	88.2	190
9 - 11 a.m.	88.5	1,936	92.6	882	88.5	381	87.2	299	80.8	374
11 - 1 p.m.	87.5	1,534	89.3	720	87.3	281	86.5	261	82.1	272
1 - 3 p.m.	88.4	2,868	91.3	1,485	90.2	520	86.5	410	79.1	453
3 - 5 p.m.	87.1	3,284	87.3	1,641	89.8	613	87.2	461	83.5	569
5 - 7 p.m.	91.5	1,604	92.0	917	92.1	285	85.5	190	84.9	212
Day of Week										
Monday	86.9	1,730	89.9	1,054	89.0	266	78.5	224	76.3	186
Tuesday	89.9	1,836	91.8	897	92.5	332	87.4	274	85.1	333
Wednesday	88.0	982	92.1	503	92.6	155	83.5	131	82.4	193
Thursday	88.9	1,995	90.8	956	90.5	347	88.2	335	83.6	357
Friday	89.7	2,525	91.9	1,217	91.7	485	85.6	381	85.5	442
Saturday	88.8	1,563	90.9	760	85.8	319	92.5	219	83.1	265
Sunday	90.8	1,737	94.5	827	89.6	404	93.1	212	82.9	294
Weather										
Sunny	89.6	7,048	92.4	3,513	90.2	1,370	89.2	984	81.2	1,181
Cloudy	87.1	5,287	88.0	2,687	90.0	936	85.1	788	83.5	876
Rainy	93.9	33	92.9	14	100.0	2	75.0	4	100.0	13
Sex										
Male	85.4	6,725	87.8	2,991	87.6	1,135	84.7	957	80.2	1,642
Female	91.8	5,638	92.3	3,219	92.1	1,173	90.5	819	89.8	427
Age										
0 - 3	45.4	3	100.0	2	100.0	1	---	0	---	0
4 - 15	91.2	395	87.7	180	96.8	80	95.8	78	89.4	57
16 - 29	86.2	3,472	88.8	2,132	87.9	569	82.3	288	76.2	483
30 - 59	88.3	6,661	90.0	2,914	90.1	1,381	87.2	1,107	83.5	1,259
60 - Up	91.2	1,833	93.0	984	90.4	276	88.6	302	86.0	271
Position										
Driver	88.3	9,608	90.6	4,848	89.3	1,785	87.1	1,315	81.7	1,660
Passenger	88.4	2,760	88.6	1,366	91.8	523	87.7	461	83.8	410

Age and Sex. Table 6 shows the estimated safety belt use rates and unweighted numbers (N) of occupants for all vehicle types combined by age and sex. Because the unweighted number of occupants is quite low for the two youngest age groups, the belt use rates should be interpreted with caution and will be excluded from the following discussion. When analyzing each sex separately, belt use for males increased with age. For females, belt use was essentially the same between 16-to-29-year-olds and 30-to-59-year-olds, but increased for the 60-up age group. Belt use for females in all age groups was higher than for males. However, the difference in belt use rates between sexes varied depending upon the age group. The most notable difference is found in the 16-to-29-year-old age group, where the estimated belt use rate is 9.0 percentage points higher for females than for males. In fact, the belt use rate for the lowest female age group (16-to-29 year olds) was higher than the rate for the highest male age group (60-up age group). These results argue strongly for statewide efforts to be directed toward persuading young males, and males in general, to wear their safety belts.

Table 6. Percent Shoulder Belt Use and Unweighted N by Age and Sex (All Vehicle Types Combined)

Age Group	Male		Female	
	Percent Use	Unweighted N	Percent Use	Unweighted N
0 - 3	---	0	100.0	3
4 - 15	89.2	218	93.4	177
16 - 29	82.0	1,802	91.0	1,668
30 - 59	85.6	3,667	91.6	2,992
60 - Up	89.5	1,036	93.4	797

DISCUSSION

The estimated statewide safety belt use rate for front-outboard occupants of passenger cars, sport-utility vehicles, vans/minivans, and pickup trucks combined was 88.3 ± 0.9 percent. This rate represents the highest level of statewide safety belt use ever observed in Michigan. Prior to the current survey, the highest statewide belt use rates previously observed were 86.8 ± 1.2 percent, in June 2004 (Eby, & Vivoda, 2004), and 84.8 ± 1.6 percent, in September, 2003 (Eby, Vivoda, & Spradlin, 2003). The current survey, considered with these two previous surveys, represents an upward trend in belt use across the state. Between the time that Michigan changed to primary enforcement, in 2000, and the surveys mentioned above, belt use had generally remained stable with minor fluctuations between 80 and 84 percent (e.g. Eby, Vivoda, & Spradlin, 2003). However, it now appears that this steady upward trend has broken through the previous plateau.

Much of this change can be attributed to increased and more focused efforts aimed at raising the belt use rate. Media campaigns coupled closely with intensive police enforcement have been implemented and continue to be effective. Additionally, the implementation of "safety belt enforcement zones" over the last two years appears to have been particularly effective, both in maintaining and further increasing the belt use rate in Michigan. Since the current survey is timed to provide baseline data before one of these mobilization efforts began, there was no additional enforcement occurring at the time of these observations. However, increases noted in the current study may be residual effects from the mobilization conducted during May and June. Alternatively, belt use may experience a natural increase or decrease during different parts of the year. For example, historically, safety belt surveys conducted during the late summer and early fall tend to reveal higher belt use than those conducted at other times of the year, while surveys conducted during the cold winter months tend to have lower belt use (see e.g., Eby & Vivoda, 2001; Eby, Vivoda, & Spradlin, 2003).

The increase in overall safety belt use throughout the state reflects increases within all of the different demographic, environmental, and vehicle related categories. For example, the increased overall belt use rate of 88.3 percent reflects increases within the demographic categories of both males and females to 85.4 and 91.8 percent, respectively. Historically, the difference in belt use between the sexes has been about 10 percentage points, however the current difference is only 6.4 percent. Males, in particular young males, have been a focus of the safety belt mobilization campaign. This reduction in the overall difference between the sexes may be a result of this focus. Additionally, as the overall belt use rate gets closer to 100 percent, it becomes increasingly difficult to change the behavior of those who continue to travel without buckling up. This is especially true within certain demographic categories (i.e. female) that have historically shown higher belt use than their comparison group (male). Since more females were buckling up to begin with, there are simply fewer non-safety belt wearers to reach.

As mentioned earlier, the current survey shows increases in nearly all demographic, environmental, and vehicle categories. As expected, the largest increases were noted in those categories that have historically shown the lowest levels of belt use. These groups have been a major focus of recent safety belt campaigns, and they may also include more "part-time" safety belt users. If the latter is the case, the intensity of the safety belt mobilization may have been effective in convincing these part-time users to buckle up, at least temporarily. However, even though larger increases in belt use were observed within these groups relative to their comparison groups, their level of belt use continues to be lower than the other groups.

The lowest levels of belt use observed in the current survey were noted within Stratum 4 (Wayne county), pickup truck occupants, males, and 16-to-29-year-olds (particularly 16-to-29-year-old males). As such, these groups should continue to be the focus of mobilization efforts. These are the same "low belt use groups" found in past studies conducted in Michigan (see e.g., Eby, Molnar, & Olk, 2000; Eby, Vivoda, & Fordyce, 2002). However, since increases in safety belt use within these groups have been larger than in their counterparts, it would appear that the messages of recent campaigns have been effective in reaching these audiences. It is still important however, to continue these efforts if the current level of belt use across the state is to be maintained and increased further.

For this goal to be accomplished, it will be necessary to implement campaigns using effective belt use messages focused toward these groups. To design these messages, there are several important criteria that must be considered. First, the low belt use groups must be identified. Second, it is important to understand why people in the low belt use groups wear safety belts less often than others; if this behavior is to be changed, the reason for it must be clearly understood. Finally, messages designed to address the target group must be tailored specifically for this group. Cognitive or cultural differences should be considered and incorporated into the messages. Understanding these issues will result in messages that address concerns of safety belt non-wearers, and are delivered in an understandable way to the target audience.

The belt use goal for Michigan has been set at 90 percent for 2004. While the current rate of 88.3 percent is very close to the goal, it is still not quite at the 90 percent level. The current survey represents baseline data prior to a mobilization effort centered around the Labor Day holiday. With a concerted effort and the proper mobilization activities and messages during the upcoming campaign, perhaps the 90 percent level can be reached.

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APPENDIX A
Site Listing

Survey Sites By Number

No.	County	Site Location	Type	Str
001	Oakland	EB Whipple Lake Rd. & Eston Rd.	I	1
*002	Kalamazoo	EB S Ave. & 29th St.	I	1
003	Oakland	SB Pontiac Trail & 10 Mile Rd.	I	1
004	Washtenaw	SB Moon Rd. & Ann Arbor-Saline Rd./Saline-Milan Rd.	I	1
005	Oakland	WB Drahner Rd. & Baldwin Rd.	I	1
006	Oakland	SB Rochester Rd. & 32 Mile Rd./Romeo Rd.	I	1
007	Oakland	SB Williams Lake Rd. & Elizabeth Lake Rd.	I	1
008	Ingham	SB Searles Rd. & Iosco Rd.	I	1
*009	Kalamazoo	WB D Ave. & Riverview Dr.	I	1
010	Washtenaw	EB N. Territorial Rd. & Dexter-Pinckney Rd.	I	1
*011	Washtenaw	NB Schleeweis Rd./Macomb St. & W. Main St.	I	1
012	Ingham	NB Shaftsburg Rd. & Haslett Rd.	I	1
013	Oakland	NB Middlebelt Rd. & 9 Mile Rd.	I	1
*014	Washtenaw	WB Packard Rd. & Carpenter Rd.	I	1
015	Ingham	EB Haslett Rd. & Marsh Rd.	I	1
*016	Washtenaw	NB Jordan Rd./Monroe St. & US-12/Michigan Ave.	I	1
017	Washtenaw	SB M-52/Main St. & Old US-12	I	1
018	Kalamazoo	SB 8th St. & Q Ave.	I	1
*019	Washtenaw	WB 8 Mile Rd. & Pontiac Trail	I	1
*020	Oakland	SB Lahser Rd. & 11 Mile Rd.	I	1
*021	Kalamazoo	NB Ravine Rd. & D Ave.	I	1
022	Washtenaw	EB Glacier Way/Glazier Way & Huron Pkwy.	I	1
023	Washtenaw	WB Bethel Church Rd. & M-52	I	1
024	Washtenaw	SB Platt Rd. & Willis Rd.	I	1
*025	Ingham	WB Fitchburg Rd. & Williamston Rd.	I	1
026	Washtenaw	EB Merritt Rd. & Stoney Creek Rd.	I	1
027	Oakland	SB Hickory Ridge Rd. & M-59/Highland Rd.	I	1
028	Kalamazoo	SB Douglas Ave. & D Ave.	I	1
*029	Oakland	WB Walnut Lake Rd. & Haggerty Rd.	I	1
030	Oakland	NB Jossman Rd. & Grange Hall Rd.	I	1
031	Kalamazoo	EB H Ave. & 3rd St.	I	1
032	Kalamazoo	EB TU Ave. & 24th St./Sprinkle Rd.	I	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.	I	2
044	Bay	WB Nebodish Rd. & Knight Rd.	I	2
045	Macomb	SB Camp Ground Rd. & 31 Mile Rd.	I	2
046	Jackson	SB Benton Rd./Moon Lake Rd. & M-50/ Brooklyn Rd.	I	2
047	Allegan	SB 6th St. & M-89	I	2
048	Kent	EB 36th St. & Snow Ave.	I	2
049	Livingston	EB Chase Lake Rd. & Fowlerville Rd.	I	2
*050	Allegan	WB 144th Ave. & 2nd St.	I	2
051	Livingston	SB Cedar Lake Rd. & Coon Lake Rd.	I	2
052	Jackson	NB Mt. Hope Rd. & Waterloo-Munith Rd.	I	2
*053	Kent	WB Cascade Rd. & Thornapple River Dr.	I	2
*054	Allegan	NB 62nd St. & 102nd Ave.	I	2
055	Kent	SB Meddler Ave. & 18 Mile Rd.	I	2
056	Eaton	SB Houston Rd. & Kinneville Rd.	I	2
057	Macomb	SB M-19/Memphis Ridge Rd. & 32 Mile Rd./ Division Rd.	I	2
*058	Allegan	NB 66th St. & 118th Ave.	I	2
059	Grn Traverse	NB Silver Lake Rd./County Rd. 633 & US-31	I	2
*060	Grn Traverse	EB Riley Rd./Tenth St. & M-137	I	2
*061	Bay	SB 9 Mile Rd. & Beaver Rd.	I	2
062	Kent	SB Ramsdell Dr. & M-57/14 Mile Rd.	I	2
*063	Eaton	NB Ionia Rd. & M-50/Clinton Trail	I	2
064	Macomb	EB 23 Mile Rd. & Romeo Plank Rd.	I	2
*065	Livingston	NB Old US-23/Whitmore Lake Rd. & Grand River Rd.	I	2
066	Jackson	SWB Horton Rd. & Badgley Rd.	I	2
067	Kent	SB Belmont Ave. & West River Dr.	I	2
*068	Eaton	EB 5 Point Hwy. & Ionia Rd.	I	2
069	Allegan	WB 129th Ave. & 10th St.	I	2
*070	Eaton	EB M-43 & M-100	I	2
071	Ottawa	WB Taylor St. & 72nd Ave.	I	2
072	Bay	EB Cass Rd. & Farley Rd.	I	2
073	Allegan	EB 126th Ave. & 66th St.	I	2

074	Bay	NB Mackinaw Rd. & Cody-Estey Rd.	I	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.	I	3
*086	Berrien	EB Mayflower Rd. & Chicago Rd.	I	3
*087	Marquette	SWB C.R. 456 & Sporley Lake Rd.	I	3
088	Lenawee	EB Munger Rd. & M-52	I	3
*089	Genesee	EB Pierson Rd. & Elms Rd.	I	3
*090	Clinton	NB Scott Rd. & M-21/State	I	3
091	Calhoun	WB R Dr. S. & 8 Mile Rd./Adolph Rd.	I	3
092	Calhoun	EB V Dr. N. & 20 Mile Rd.	I	3
093	Calhoun	NWB Dickman Rd./M-96 & Avenue A	I	3
094	St. Clair	WB Hewitt Rd. & Fargo Rd.	I	3
095	Monroe	SB Swan Creek Rd. & Labo Rd.	I	3
*096	Muskegon	EB Sweeter Rd. & Maple Island	I	3
*097	Calhoun	SB P Dr. N./Yawger Rd. & Hubbard Rd./5 Mile Rd.	I	3
098	St. Clair	WB Bryce Rd. & Cribbins Rd.	I	3
099	St. Clair	WB Lindsey Rd. & Palms Rd.	I	3
100	Van Buren	SB Broadway/M-140 & Phoenix Rd./BL I-196/C.R. 388	I	3
101	Ionia	SB Fisk Rd./Heffron Rd. & Montcalm Ave.	I	3
102	Clinton	EB Taft Rd. & Shepardsville Rd.	I	3
103	Calhoun	SB S. County Line Rd. & 23 Mile Rd.	I	3
*104	Calhoun	NB Waubascon Rd./4 1/2 Mile Rd. & Baseline Rd.	I	3
105	Monroe	WB Day Rd. & Ann Arbor Rd.	I	3
106	St. Joseph	WB Balk Rd./C.R. 139 & Grim Rd./Sherman Mills Rd.	I	3
107	Lapeer	EB Armstrong/C.R. 7 & M-53/Van Dyke Hwy.	I	3
*108	Saginaw	SB Chapin N./Kane Rd. & Frost Rd.	I	3
109	St. Clair	SB Werner/Ellsworth & Gratiot	I	3
110	Lenawee	NB Ogden Hwy. & US-223	I	3
111	Lapeer	SB Wheeling Rd. & Bowers Rd./M-52	I	3
112	Saginaw	NB Raucholz Rd. & Ithaca Rd.	I	3
*113	Shiawassee	NEB Winegar Rd. & Lansing Rd.	I	3
114	St. Joseph	SB Rosenbaugh Rd./40th St. & Michigan Ave./C.R. 120	I	3
*115	Saginaw	NB East Rd. & Ditch Rd.	I	3
116	Muskegon	EB Heights-Ravenna Rd. & Sullivan Rd.	I	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.	I	4
*128	Wayne	EB Warren Rd. & Wayne Rd.	I	4
129	Wayne	EB McNichols Rd. & Woodward Ave.	I	4
*130	Wayne	NB Canton Center Rd. & Cherry Hill Rd.	I	4
131	Wayne	WB Ecorse Rd. & Pardee Rd.	I	4
132	Wayne	EB Michigan Ave. & Sheldon Rd.	I	4
*133	Wayne	EB Ecorse Rd. & Middlebelt Rd.	I	4
*134	Wayne	NB M-85/Fort Rd. & Emmons Rd.	I	4
135	Wayne	WB Glenwood Rd. & Wayne Rd.	I	4
136	Wayne	NB Haggerty Rd. & 7 Mile Rd.	I	4
*137	Wayne	WB 6 Mile Rd. & Inkster Rd.	I	4
138	Wayne	SB Inkster Rd. & Goddard Rd.	I	4
139	Wayne	SB Merriman Rd. & Cherry Hill Rd.	I	4
140	Wayne	SEB Outer Dr. & Pelham Rd.	I	4
*141	Wayne	NB Meridian Rd. & Macomb Rd.	I	4
142	Wayne	WB Ford Rd. & Venoy Rd.	I	4
*143	Wayne	SWB Vernor Rd. & Gratiot Rd.	I	4
144	Wayne	WB 5 Mile Rd. & Beck Rd.	I	4
145	Wayne	EB 7 Mile Rd. & Livernois Rd.	I	4
*146	Wayne	NB Gunston/Hoover Rd. & McNichols Rd.	I	4

147	Wayne	SB W. Jefferson/ Biddle Ave. & Southfield Rd.	I	4
148	Wayne	EB Goddard Rd. & Wayne Rd.	I	4
*149	Wayne	WB 8 Mile Rd. & Kelly Rd.	I	4
150	Wayne	SB Merriman Rd. & US-12/Michigan Ave.	I	4
151	Wayne	SB Telegraph Rd. & Plymouth Rd.	I	4
*152	Wayne	WB Sibley Rd. & Inkster Rd.	I	4
153	Wayne	NEB Mack Rd. & Moross Rd.	I	4
154	Wayne	WB Annapolis Rd. & Inkster Rd.	I	4
*155	Wayne	SB Greenfield Rd. & Grand River Rd.	I	4
156	Wayne	EB Joy Rd. & Livernois Rd.	I	4
157	Wayne	SEB Conner Ave. & Gratiot Rd.	I	4
158	Wayne	NWB Grand River Rd. & Wyoming Ave.	I	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 & Gibralter 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 B
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:

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

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:

$$var(r_{all}) = \frac{var(r_1) + var(r_2) + var(r_3) + 0.83^2 \times var(r_4)}{3.83^2}$$

The Wayne County stratum variance was multiplied by 0.83 to account for the similar weighting that was done to estimate overall belt use. The 95 percent confidence bands were calculated using the formula:

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

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:

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

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

APPENDIX C
PDA Data Collection Details

During the current study, all data collection was conducted using Personal Digital Assistants (PDAs). The transition from paper to PDA data collection was made primarily to decrease the time necessary to move from the end of the data collection phase of a survey to data analysis. With paper data, there is automatically two to three weeks of additional time built-in while the paper data are being entered into an electronic format. Before making this transition, a pilot study was conducted to compare data collection by PDA to paper. Several key factors were tested during the pilot study including accuracy, volume (speed), ease of use, mechanical issues (i.e. battery life), and environmental issues (i.e. weather, daylight). The pilot study found PDA use to be equal to or better than paper data collection on every factor tested. Before making the change to PDA data collection, electronic versions of the *Site Description Form* and *Observation Form* were developed. The following pages show examples of the electronic forms and discuss other factors related to using PDAs for safety belt data collection.

The goal of adapting the existing paper forms to an electronic format was to create electronic forms that were very similar to the paper forms, while taking advantage of the advanced, built-in capabilities of the PDA. As such, the electronic *Site Description Form* incorporated a built-in traffic counter, used the PDA's calendar function for date entry, and included high resolution color on the screens. The first screen of the *Site Description Form* (Figure 2) allows users to type in the site location (street names and standing location). Observers use the PDA stylus to tap on the appropriate choices of site type, site choice, and traffic control. If a mistake is made, the observer can change the data they have input, simply by tapping on the correct choice. All selected choices appear highlighted on the screen.

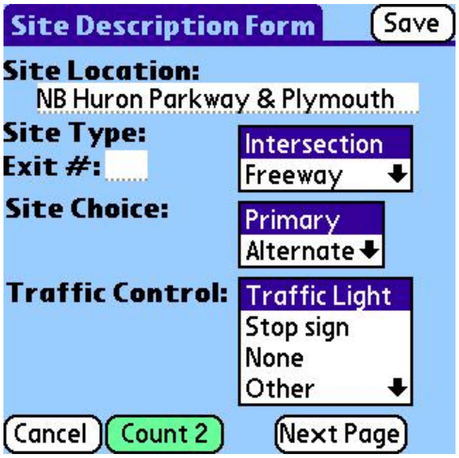

Figure 2. Site Description Form - Screen 1

Screens 2 and 3 are shown in Figure 3. As seen in this figure, observers enter their name, the weather, day of week, and median information simply by tapping the appropriate choice on the display list. Date is entered by tapping on the “Date” button. This brings up a calendar for observers to tap on the appropriate date. Screen 3 allows users to sketch in the intersection and show where they are standing, and to record the start time for the site.

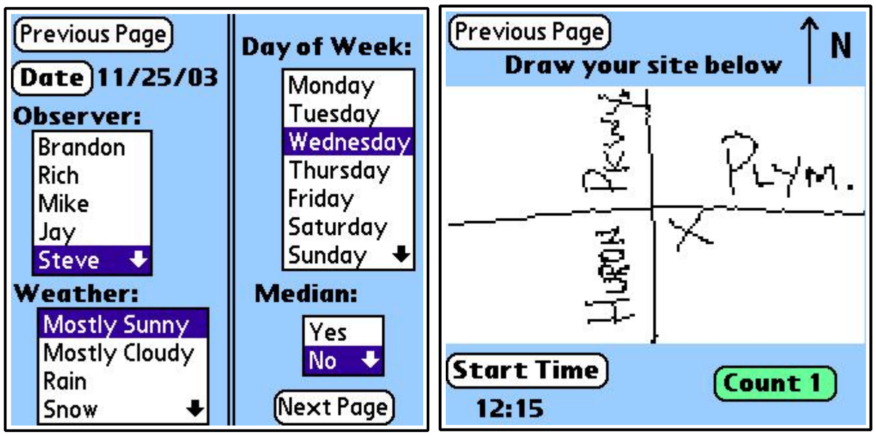

Figure 3. Site Description Form - Screens 2 and 3

In the past, observers had to put away their paper form, get out a mechanical traffic counter, and begin a traffic count after entering the start time. Using a PDA, it is possible to incorporate a traffic counter directly into the *Site Description Form*[7]. Figure 4 shows an example of the electronic traffic counter screen of the *Site Description Form*. To count each vehicle that passes, observers tap on the large “+” button. The size of this button allows the observer to tap the screen while keeping their eyes on the roadway. Each tap increases the count that is displayed at the top of the screen. If a mistake is made, the observer can decrease the count by tapping on the small “-“ button on the left of the screen.

[7]The PDA traffic counting method was compared with a mechanical counter during the pilot testing and no difference was found between the two methods.

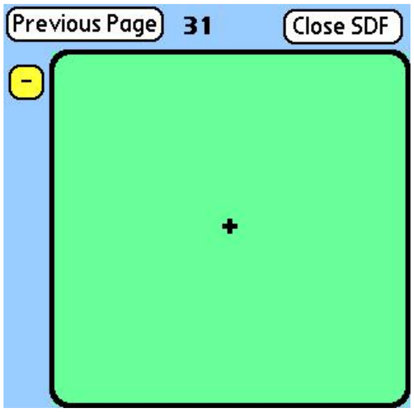

Figure 4. Site Description Form - Traffic Counter Screen

The last screen of the electronic *Site Description Form*, shown in Figure 5, allows the user to enter the end time of the site observation and interruption (if any). Finally, observers can type in any comments regarding the site or traffic flow that may be important.

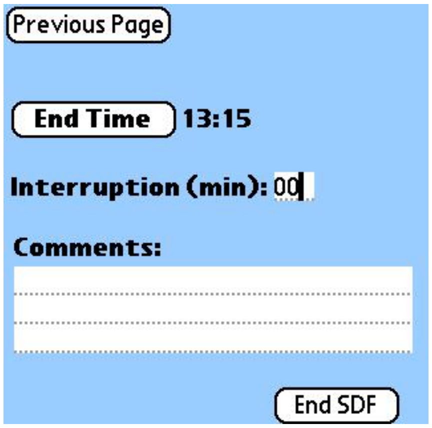

Figure 5. Site Description Form - Final Screen

To allow for easier data entry, the electronic *Observation Form* was divided into three screens, one for driver information, one for front-right passenger information, and one for vehicle information. As shown in Figure 6, each screen is accessible by tapping on the appropriate tab along the top of the screen. The screens have also been designed with different colors, with the driver screen blue, passenger screen green, and vehicle screen yellow. As shown below, the first screen that appears in the form is the driver screen. Each category of data, along with the choices for each category, are displayed on the screen. As in the Site Description Form, users simply tap on the choices that correspond to the motorist that is being observed. These data then appear highlighted on the screen.

Since most motorists are not actively using a cellular phone while driving, “No Cell Phone” is already highlighted as a default. If the motorist is using a cell phone, the proper choice can simply be selected from the list.

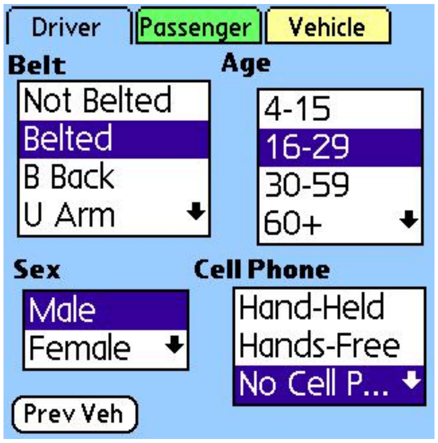

Figure 6. Observation Form - Driver Screen

Figure 7 shows the passenger and vehicle screens from the *Observation Form*. If no passenger is present, users tap on the “No Passenger” area to put a check mark in that box. On the vehicle screen, “Not Commercial” is selected as a default since the majority of observed vehicles are not used for commercial purposes. Once data are complete for one vehicle, observers tap the “Next Vehicle” button to continue collecting data.

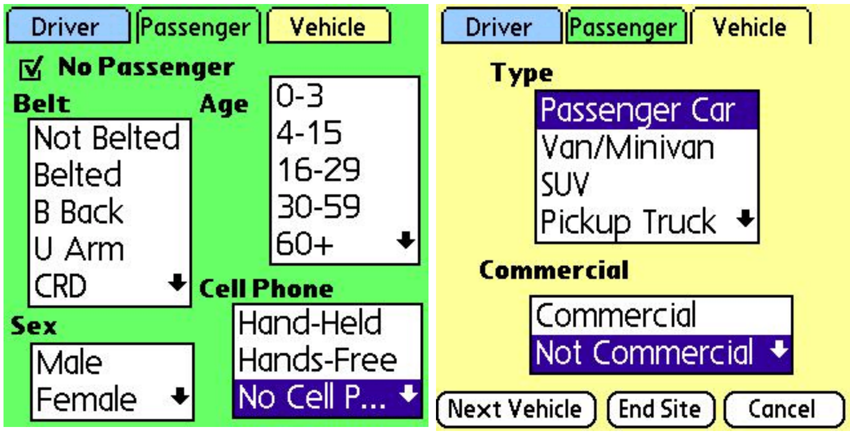

Figure 7. Observation Form - Passenger and Vehicle Screens

Each PDA also had a built-in cellular phone as well as wireless e-mail capability. At regular intervals, usually twice a day, observers e-mailed completed data directly from the PDA to the project supervisor. *Site Description* and *Observation Forms* from completed sites were “zipped,” using a compression program, and then transmitted directly to a pre-determined e-mail account. The e-mailing of data allowed the project field supervisor to immediately check data for errors, and begin to compile a data analysis file as the project progressed. After data transmission, the observer transferred the site data from the internal memory of the PDA to a Secure Digital (SD) memory card.