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DIRECT OBSERVATION OF SAFETY BELT USE IN MICHIGAN: FALL 2003

David W. Eby, Ph.D.
Jonathon M. Vivoda, B.A.
Helen K. Spradlin, B.S.

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16. Abstract

A direct observation survey of safety belt use in Michigan was conducted in the fall of 2003. In this study, 11,723 occupants traveling in four vehicle types (passenger cars, sport-utility vehicles, vans/minivans, and pickup trucks) were surveyed between August 28 and September 10, 2003. Belt use was estimated for all commercial/noncommercial vehicle types combined (the statewide safety belt use rate) and separately for each vehicle type. Within and across each vehicle type, belt use by age, sex, road type, day of week, time of day, and seating position were calculated. Statewide belt use was 84.8 percent. This rate represents the highest level of statewide safety belt use ever observed in Michigan. A comparison with the highest safety belt use rate observed before the introduction of primary enforcement shows that the current rate reflects a 14.7 percentage point increase. Belt use was 86.8 percent for passenger cars, 85.4 percent for sport-utility vehicles, 86.3 percent for vans/minivans, and 77.8 percent for pickup trucks. For all vehicle types combined, belt use was higher for females than for males, and higher for drivers than for passengers. In general, belt use was high during the morning and evening rush hours. Belt use did not vary systematically by day of week. Belt use was lowest among 16-to-29 year olds, and highest among the 60-and-older age group. Survey results suggest that the implementation of primary enforcement safety belt use laws and the accompanying enforcement and public information and education efforts have been effective in maintaining and continuing to increase safety belt use in Michigan.

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CONTENTS

LIST OF FIGURES

LIST OF TABLES

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David W. Eby, Ph.D.
Jonathon M. Vivoda, B.A.
Helen K. Spradlin, B.S.

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INTRODUCTION

In 1983, the level of safety belt use in the United States was only 14 percent overall (Haseltine, 2001). However, this extremely low belt use rate was not due to a lack of available restraint systems in vehicles. In fact, safety belt systems had been installed in all cars manufactured in the U.S. since 1964, with combination lap/shoulder belts installed in all U.S. cars since 1968 (Haseltine, 2001). Therefore, the most obvious reason for this extremely low belt use is that safety belt use in vehicles was not mandatory. Understanding the implications of this exceptionally low belt use rate, traffic safety professionals tried several means to convince the motoring public to buckle-up. The earliest of these efforts relied on advertising campaigns focusing on educating the public about the value of safety belts. Unfortunately, these purely educational activities were largely unsuccessful. The next attempt at increasing safety belt use began in 1974 with the introduction of a requirement for all new cars to have ignition interlock devices. These devices prevented the vehicle from being started until the occupants were wearing safety belts. While these devices were successful at increasing the belt use rate for equipped vehicles, consumer complaints led Congress to amend the law that required interlocks.

Following these failures, traffic safety experts began to push for the introduction of mandatory use laws (MULs) for safety belts throughout the U.S. Beginning in 1984, a number of states were successful in implementing these MULs. As expected, safety belt use in these states increased markedly. As more and more states began to implement these types of mandatory use laws around the country, the belt use rate for the U.S. as a whole continued to rise. By 1989, the belt use rate in the U.S. had risen to 49 percent (Haseltine, 2001).

While the gains that resulted from the introduction of MULs increased belt use in the U.S. by 35 percent, the leveling off of the use rate in any given state after the introduction of the MUL began to be recognized as a problem. The belt use increase of 35 percent had resulted in a large reduction in motor vehicle related injuries and fatalities, but traffic safety professionals were eager to continue to increase these gains. However, since a mandatory use law was already in place in many states, it was necessary to develop a new strategy to increase belt use. This new strategy came in the form of Public Information and Education (PI&E) campaigns and increased police enforcement of the belt use laws. These new campaigns educated the public about the necessity and effectiveness of wearing a safety belt, and reminded the public about the law, with slogans such as "Buckle Up, It's The Law." Another innovative program designed to increase belt use came in the form of the popular "Vince and Larry" crash test dummy television commercials. These commercials attempted to educate children, as well as the general public, as to the importance of buckling-up by using comedy and showing the outcome of failure to wear a safety belt. Throughout the 1990s, these types of programs were somewhat successful at continuing to gradually increase safety belt use across the country and within many states.

Near the end of the '90s however, the level of belt use in most states had reached a plateau around 65 to 70 percent. At this point, most experts believed that the most effective way for a state to increase safety belt use, and break through the apparent plateau, was to re-examine its safety belt law and make a legislative change to allow for primary (standard) enforcement. This change was necessary because most of the original MULs implemented at the state level in the mid-1980s contained a provision known as secondary enforcement. This provision only allowed police officers to stop and cite a motorist for safety belt non-use if they were observed violating some other law as well. In other words, if a motorist was otherwise complying with all other traffic laws, they could not be stopped solely for failing to buckle-up. By the end of the '90s, there was increasing evidence that states with primary enforcement provisions had higher belt use rates, and further, the few states that had already made the change from secondary to primary enforcement had experienced a sharp increase in belt use directly related to this change.

Throughout the end of the '90s and even now, many states continue to change their respective safety belt laws to primary enforcement. Nearly every state that has made this change has noted an upward trend in belt use similar to those experienced when the MULs were first introduced in the mid-80s. Specifically, these legislative changes have been followed by an immediate sharp increase in belt use, followed by a slight decline, and then a leveling off of the belt use rate. In fact, this trend is exactly what was observed in Michigan when the law was changed in March, 2000. As other secondary enforcement states continue to make the change to primary enforcement, the overall belt use rate for the U.S. will continue to rise, reflecting the increases realized within the individual states. However, the challenge for states that have already changed to primary enforcement is to develop a new strategy to at least stabilize the belt use rate at the new high levels, and preferably to continue to increase the use rate.

Campaigns that attempt to simply educate the public are generally no longer successful since the vast majority of the public now accepts that safety belts are effective in reducing injuries and fatalities sustained in a motor vehicle crash. Current campaigns have changed focus and have been successful in increasing belt use by attempting to change motorists' perceived risk of receiving a citation and the perceived seriousness of the consequences related to the citation. This has been accomplished by pairing media messages such as "Click It Or Ticket" and "Buckle Up or Pay Up," with a marked increase in police enforcement. In Michigan, this increased police enforcement has taken the form of zero-tolerance saturation patrols or enforcement zones. These enforcement zones implement a zero-tolerance police presence on a given stretch of roadway, during which one officer serves as a spotter and radios information about unbelted motorists to a marked patrol car that pulls over and cites the offender. "Safety belt enforcement zone" signs alert motorists when they enter the zone (Michigan Office of Highway Safety Planning, OHSP, 2003). A pilot test of an enforcement zone mobilization in Michigan was successful in increasing belt use in May and June, 2003.

The purpose of the current survey is to assess continuing efforts, including safety belt mobilizations, designed to increase safety belt use statewide. To maintain and increase belt use, it is necessary to understand the overall effects of these media and enforcement campaigns, as well as how various sub-populations are differentially affected by these programs. A secondary purpose of the study is to continue to track the changes in belt use that have occurred since the first mandatory safety belt use law was implemented in Michigan. The current study represents the thirty-third wave in a series of statewide direct observation surveys conducted in Michigan since 1984. This survey will identify overall changes in safety belt use, along with belt use changes within specific demographic groups in Michigan.

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, National Highway Traffic Safety Administration, 1992, 1998c). 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. Census Bureau, 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 among counties (U.S. Census Bureau, 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 original 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. Census Bureau, 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 increased to 168 to get an adequate representation of belt use for each day of the week and for all daylight hours.

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

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 (24 percent) of the sites 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

[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.

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/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.

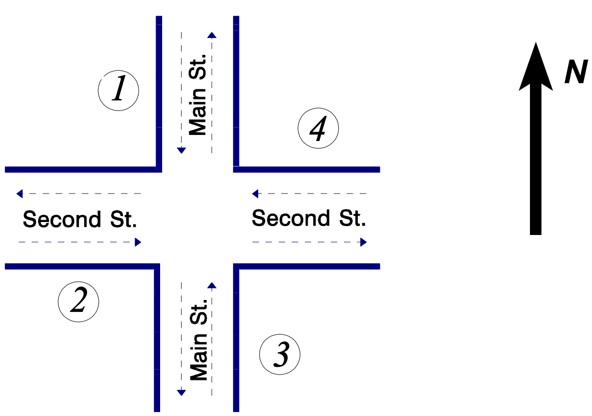

Figure 1. An Example "+" Intersection Showing 4 Possible Observer Locations.

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.

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[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 quasi-randomly 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 one 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 selected days and/or times 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 quasi-random 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

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

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. 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 weather conditions, with a smaller percentage conducted during cloudy weather. A small percentage of observations were conducted during rainy weather, and 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	69.1%
Tuesday	13.1%	9-11 a.m.	19.1%	Alternate	1.2%	Cloudy	23.8%
Wednesday	11.3%	11-1 p.m.	17.3%			Rain	7.1%
Thursday	16.7%	1-3 p.m.	22.6%			Snow	0.0%
Friday	17.2%	3-5 p.m.	20.2%				
Saturday	14.3%	5-7 p.m.	10.1%				
Sunday	13.7%						
TOTALS	100%		100%		100%		100%

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 from August 28 through September 10, 2003. 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. The cellular phone use of occupants were also noted during data collection, but not analyzed in this study. 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 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 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. 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 drop off 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, computer analysis programs 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.

[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.

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:

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

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 (see Table 1). 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 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 direct observation survey of safety belt use in Michigan reports statewide belt use for four vehicle types combined (passenger cars, vans/minivans, sport-utility vehicles, and pickup trucks), in addition to reporting use rates for occupants in each vehicle type separately. Following NHTSA (1999) guidelines, this survey included commercial vehicles. In the sample, only 5.0 percent of occupants were in commercial vehicles. In order to determine if the inclusion of commercial vehicles significantly changed statewide belt use rates, the statewide rate was calculated separately both with and without commercial vehicles. Analysis showed that there was no difference between the rates. Thus, all rates shown in this report include occupants from both commercial and noncommercial vehicles together.

Overall Safety Belt Use

As shown in Figure 2, 84.8 percent ± 1.6 percent of all front-outboard occupants traveling in either passenger cars, sport-utility vehicles, vans/minivans, or pickup trucks in Michigan between August 28 and September 10, 2003 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 83.2 percent and 86.4 percent. When compared with the use rate observed one year ago, in September 2002 (Vivoda & Eby, 2002), of 82.9 ± 1.6 percent, we find that belt use has increased slightly. In fact, the current belt use rate is the highest statewide belt use rate ever observed in Michigan.

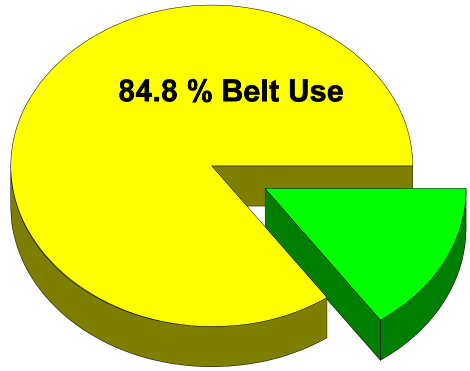

Figure 2. Front-Outboard Shoulder Belt Use in Michigan (All Vehicle Types and Commercial/Noncommercial Combined).

Estimated belt use rates and unweighted numbers of occupants (N) by stratum are shown in Table 3. Safety belt use was the highest, and nearly the same, in Strata 1 and 2. Belt use was slightly lower in Stratum 3, and lower still in Stratum 4. When compared with the September, 2002 stratum belt use rates of 87.0, 82.6, 81.7, and 80.0 percent for Strata 1 through 4, respectively, we find increases within Strata 2, 3, and 4, while belt use in Stratum 1 has remained essentially the same.

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

	Percent Use	**Unweighted N**
Stratum 1	86.4	3,450
Stratum 2	86.6	2,379
Stratum 3	84.5	1,359
Stratum 4	81.3	4,535
STATE OF MICHIGAN	**84.8 ± 1.6 %**	11,723

Estimated belt use rates and unweighted numbers of occupants by stratum and vehicle type are shown in Tables 4a through 4d. Within each vehicle type, we find no systematic differences in safety belt use by stratum. When compared with the results from September 2002, we find slight increases in shoulder belt use for occupants of passenger cars, vans/minivans, and pickup trucks. However, these changes are not statistically significant. Belt use for occupants of sport-utility vehicles remained nearly identical between these two surveys. However, it is important to note that the overall belt use rate of 77.8 ± 3.1 percent for pickup trucks was significantly lower than for any other vehicle type (Table 4d). This finding is consistent with results from previous surveys (e.g., Eby, Fordyce, & Vivoda, 2000; Eby & Vivoda, 2001; Eby, Vivoda, & Fordyce, 1999; 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	87.6	1,719
Stratum 2	89.7	1,110
Stratum 3	87.2	663
Stratum 4	81.8	2,550
STATE OF MICHIGAN	**86.8 ± 1.8 %**	6,042

Table 4b. Percent Shoulder Belt Use by Stratum (Sport-Utility Vehicles)		
	Percent Use	Unweighted N
Stratum 1	86.8	644
Stratum 2	86.7	433
Stratum 3	85.9	203
Stratum 4	81.4	819
STATE OF MICHIGAN	**85.4 ± 2.4 %**	2,099

Table 4c. Percent Shoulder Belt Use by Stratum (Vans/Minivans)		
	Percent Use	Unweighted N
Stratum 1	88.8	525
Stratum 2	85.9	378
Stratum 3	87.1	164
Stratum 4	82.6	618
STATE OF MICHIGAN	**86.3 ± 2.8 %**	1,685

Table 4d. Percent Shoulder Belt Use by Stratum (Pickup Trucks)		
	Percent Use	Unweighted N
Stratum 1	78.3	562
Stratum 2	78.9	458
Stratum 3	76.5	329
Stratum 4	77.6	548
STATE OF MICHIGAN	**77.8 ± 3.1 %**	1,897

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 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.

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 that included Labor Day. 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 only occurred at about 7 percent of the sites, comparisons of safety belt use by this weather condition are problematic.

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).

Age. Estimated safety belt use by age, vehicle type, and all vehicle types combined is shown in Table 5. As there were only four 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. Belt use rates for the 16-to-29-year-old age group were the lowest, while rates for the 30-to-59-year-old age group were between these two age groups. Belt use for the 4-to-15-year-old age group was slightly higher than the 16-to-29-year-old age group, but should be interpreted with caution since the unweighted N of this group was also quite small. 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 be a focus of safety belt use messages and programs. Comparing these results with last year's safety belt use rates by age, we find that belt use has increased slightly across the three age groups older than 15 years of age, while a slight decrease was noted among occupants age 4-to-15. The belt use rate of 81.3 for the 16-to-29-year-old age group continues the trend of this age group having lower belt use than the other age groups.

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 drivers is slightly higher than use by front-right passengers. This trend was observed in occupants of passenger cars, sport-utility vehicles, and vans/minivans, but not in occupants of pickup trucks.

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	82.1	8,072	85.0	4,177	82.9	1,424	83.4	1,173	73.2	1,298
Exit Ramp	89.0	3,651	90.1	1,865	88.9	675	90.4	512	84.8	599
Time of Day										
7 - 9 a.m.	87.7	1,382	88.7	752	85.4	263	89.6	175	85.3	192
9 - 11 a.m.	83.0	1,798	86.4	843	82.8	300	84.6	262	75.6	393
11 - 1 p.m.	84.4	1,488	85.4	725	90.1	230	84.6	266	75.4	267
1 - 3 p.m.	83.7	2,781	85.8	1,449	84.1	519	86.1	423	73.4	390
3 - 5 p.m.	83.3	2,673	84.8	1,393	85.3	485	83.1	359	78.2	436
5 - 7 p.m.	86.7	1,601	92.6	880	87.3	302	85.8	200	67.2	219
Day of Week										
Monday	82.3	1,820	84.6	1,122	84.0	306	77.8	221	74.9	171
Tuesday	88.1	1,447	89.6	717	89.2	265	88.7	205	82.8	260
Wednesday	88.3	699	90.7	352	90.9	105	82.3	105	90.8	137
Thursday	85.5	1,930	89.3	1,000	88.7	292	84.7	273	74.8	365
Friday	82.4	2,367	86.8	1,213	85.7	377	81.7	337	72.4	440
Saturday	84.8	1,548	87.0	720	90.0	339	83.0	225	75.7	264
Sunday	86.9	1,912	85.7	918	83.9	415	93.6	319	84.6	260
Weather										
Sunny	84.9	7,419	86.7	3,719	85.0	1,334	86.9	1,092	78.7	1,274
Cloudy	86.2	2,939	88.5	1,497	88.5	536	86.7	428	77.9	478
Rainy	78.2	1,365	81.1	826	80.5	229	79.9	165	66.0	145
Sex										
Male	81.1	6,198	84.1	2,837	81.8	1,006	81.4	850	76.2	1,505
Female	88.9	5,525	89.1	3,205	88.5	1,093	90.8	835	84.3	392
Age										
0 - 3	55.4	4	85.6	3	---	0	0.0	1	---	0
4 - 15	83.4	264	79.3	125	79.0	49	93.4	52	86.3	38
16 - 29	81.3	3,464	83.7	2,164	82.8	508	80.1	307	72.8	485
30 - 59	85.5	6,449	87.7	2,796	86.3	1,387	87.5	1,079	78.5	1,187
60 - Up	89.6	1,541	91.1	954	89.2	155	88.1	246	86.2	186
Position										
Driver	85.1	9,210	87.4	4,758	85.7	1,647	86.8	1,269	77.5	1,536
Passenger	83.5	2,513	84.3	1,284	84.1	452	84.4	416	79.5	361

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. Belt use for females in all age groups was higher than for males. However, the absolute 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 11.1 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 nearly the same as 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. When compared with the belt use rates by age and sex from September 2002, the current rates either increased slightly or stayed the same.

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	54.6	2	45.4	2
4 - 15	83.2	149	86.3	115
16 - 29	75.6	1,671	86.7	1,793
30 - 59	82.2	3,581	89.5	2,868
60 - Up	87.0	794	91.9	747

Historical Trends

The current direct observation survey is the eighteenth statewide survey that utilizes the sampling design and procedures implemented in 1993 (Streff, Eby, Molnar, Joksch, & Wallace, 1993). As such, it is possible to investigate safety belt use trends over these years. The annual survey in 1993, however, only included passenger vehicles, so that survey is only included in the historical trends section relating safety belt use by vehicle type.

Overall Belt Use Rate. Figure 3 shows the statewide safety belt use rate for all vehicles combined over the last 10 years. The safety belt use rate has shown a consistent increase over this time. Since 1994, the safety belt use rate has increased by 22.1 percentage points, with an increase of 14.7 percentage points over the highest rate observed before the introduction of primary enforcement, in March 2000. This finding indicates that efforts to increase safety belt use in Michigan have been effective and should be continued.

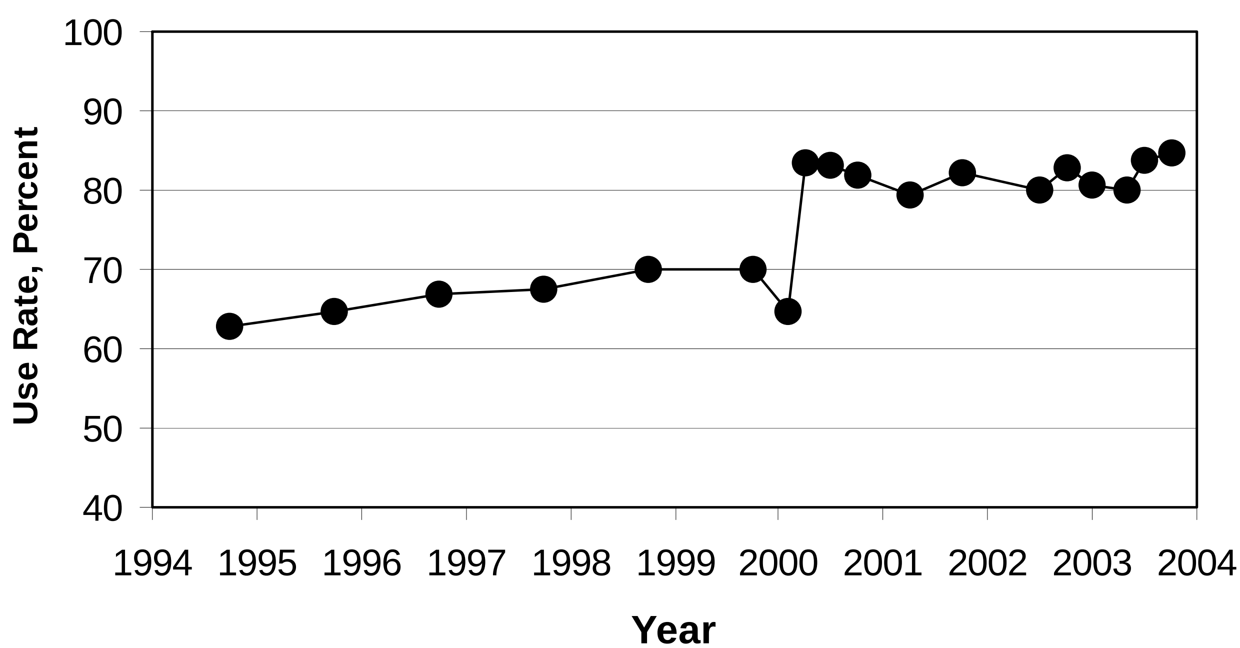

Figure 3. Front-Outboard Shoulder Belt Use by Year (All Vehicle Types Combined).

Overall Belt Use Rate by Stratum. Figure 4 shows the statewide safety belt use rate for all vehicles combined since 1994 by stratum. For all strata, there is a general upward trend in safety belt use from 1994 to 2003, with the greatest increase in use (26.1 percentage points) found in Stratum 4. Stratum 4 also experienced the largest increase in belt use immediately following the implementation of primary enforcement. Generally, overall increases in belt use rates continue to be observed in all strata, however, continuing to implement programs designed to increase belt use remains necessary to maintain the current rates, and continue to make increases.

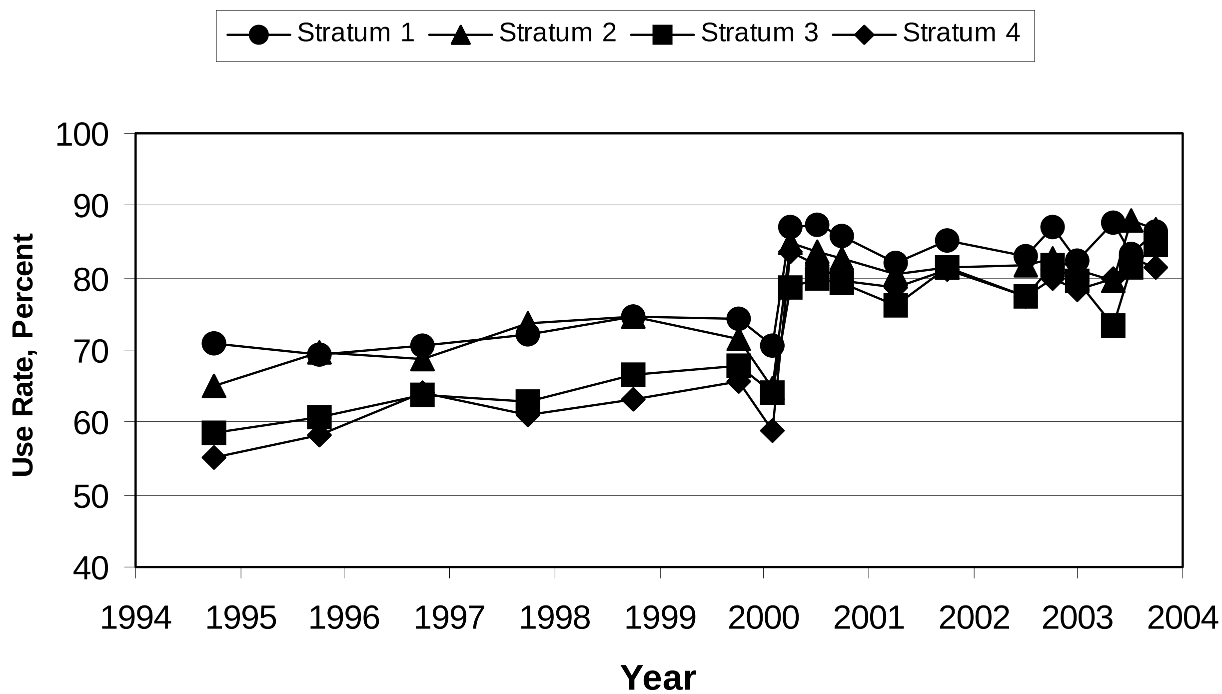

Figure 4. Front-Outboard Shoulder Belt Use by Year and Stratum (All Vehicle Types Combined).

Belt Use by Site Type. Figure 5 shows the estimated safety belt use rates for all vehicles combined as a function of whether the site was a freeway exit ramp or a local intersection. This effect has generally remained consistent since 1994, with higher belt use observed at freeway exit ramp sites, but the overall difference in belt use observed at the two types of sites has fluctuated from study to study. In the current survey, the belt use observed at exit ramps was 6.9 percentage points higher than at intersection sites.

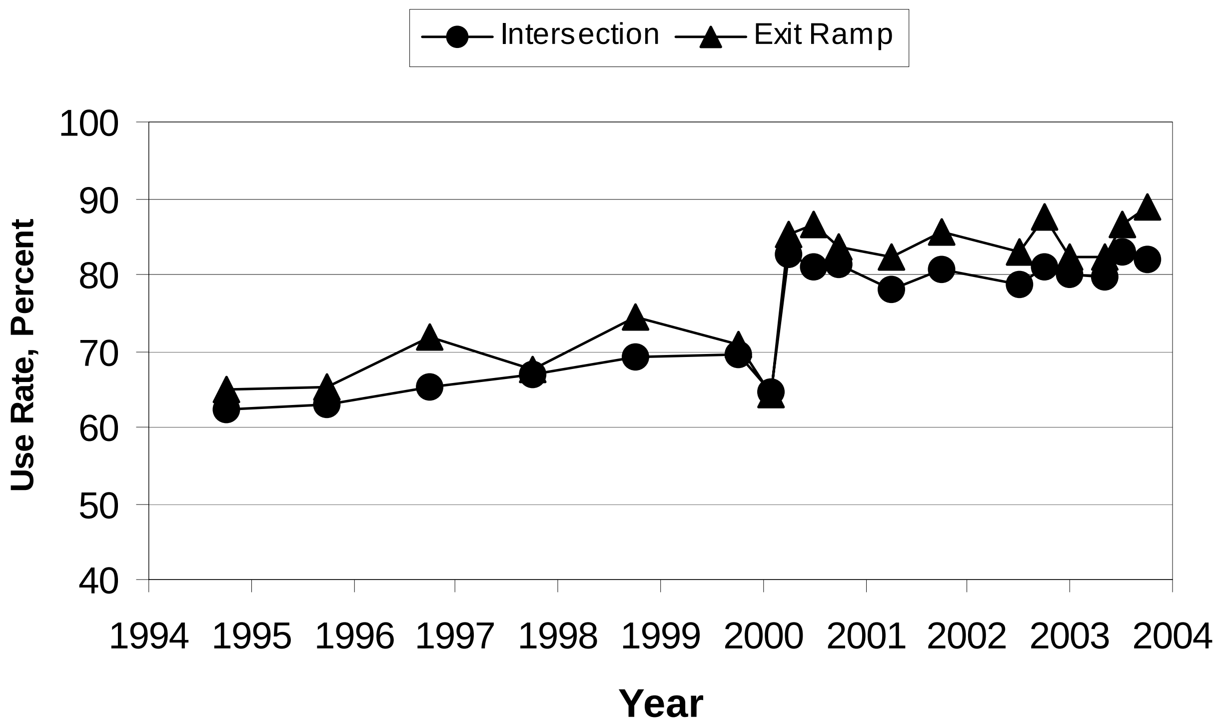

Figure 5. Front Outboard Shoulder Belt Use by Site Type and Year (All Vehicle Types Combined).

Belt Use By Sex. Figure 6 shows front-outboard safety belt use by sex since 1994. Safety belt use by females for every survey is significantly higher than for males. Significant increases in belt use, related to the introduction of primary enforcement legislation, were observed within both sexes.

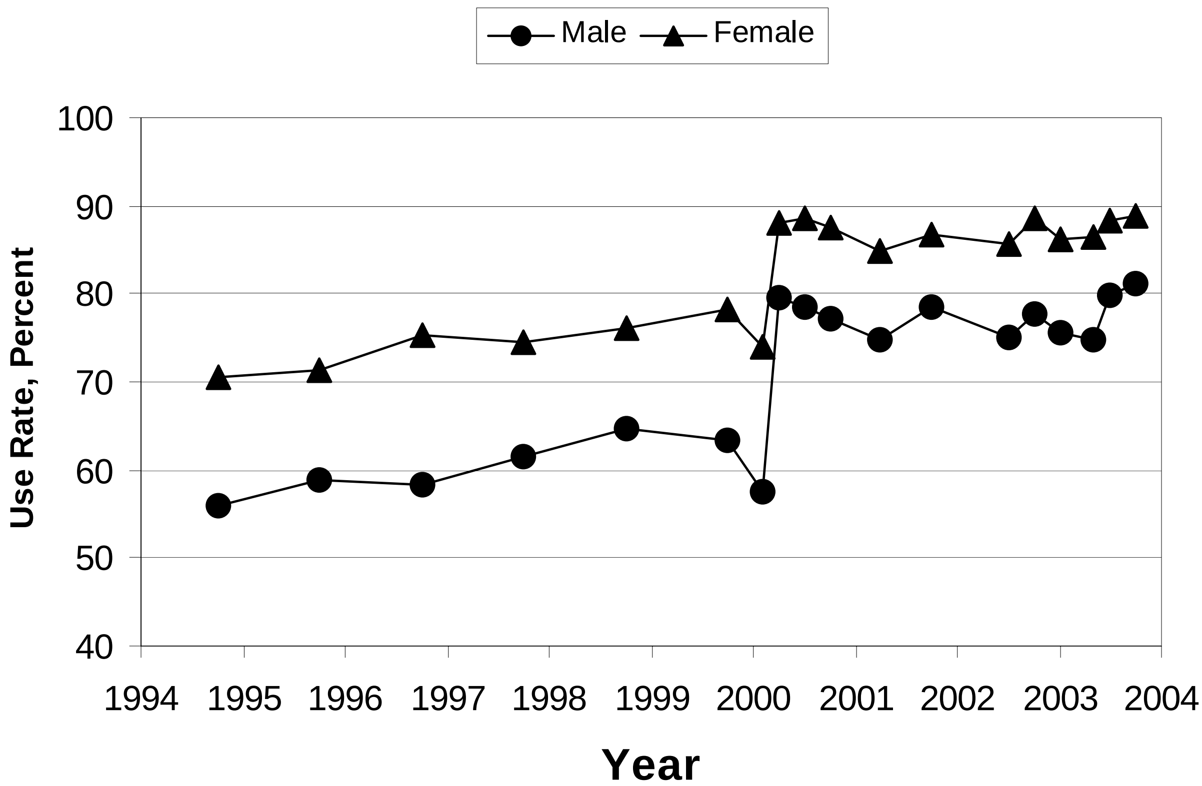

Figure 6. Front-Outboard Shoulder Belt Use by Sex and Year (All Vehicle Types Combined).

Belt Use By Seating Position. Figure 7 shows front-outboard safety belt use by seating position and year. Safety belt use by drivers has been consistently higher than for front-outboard passengers since 1994, with little change in the absolute difference between the two.

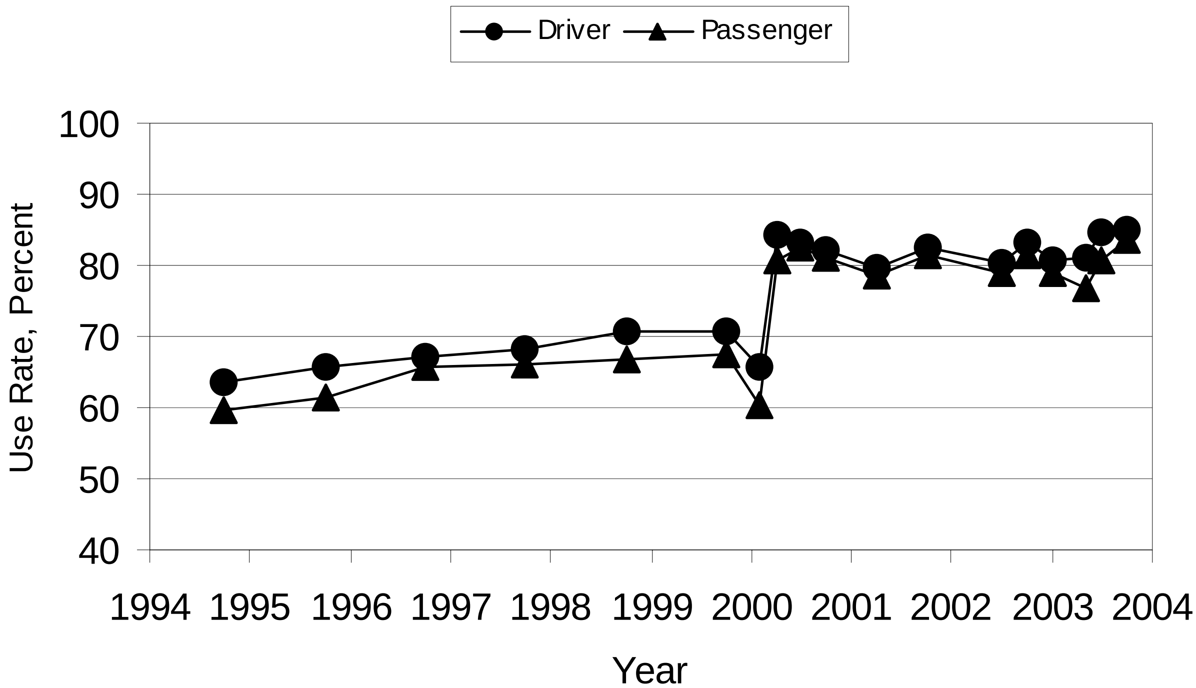

Figure 7. Front-Outboard Shoulder Belt Use by Seating Position (All Vehicle Types Combined).

Belt Use by Age. Figure 8 shows front-outboard safety belt use by age group since 1994 for all vehicles combined. The youngest age group is typically excluded from comparisons due to the very small numbers in our sample. Conclusions about the 4-to-15-year-old age group should also be made with caution as the number of occupants within this age group is quite low. Excluding these age groups, the use rates by age have been ordered consistently each year with the 16-to-29-year-old age group having the lowest safety belt use rates, followed by the 30-to-59 year olds. The highest belt use is observed within the 60-up age group. These trends continue to be evident in the current survey, with significant increases noted among all of the age groups since the introduction of primary enforcement.

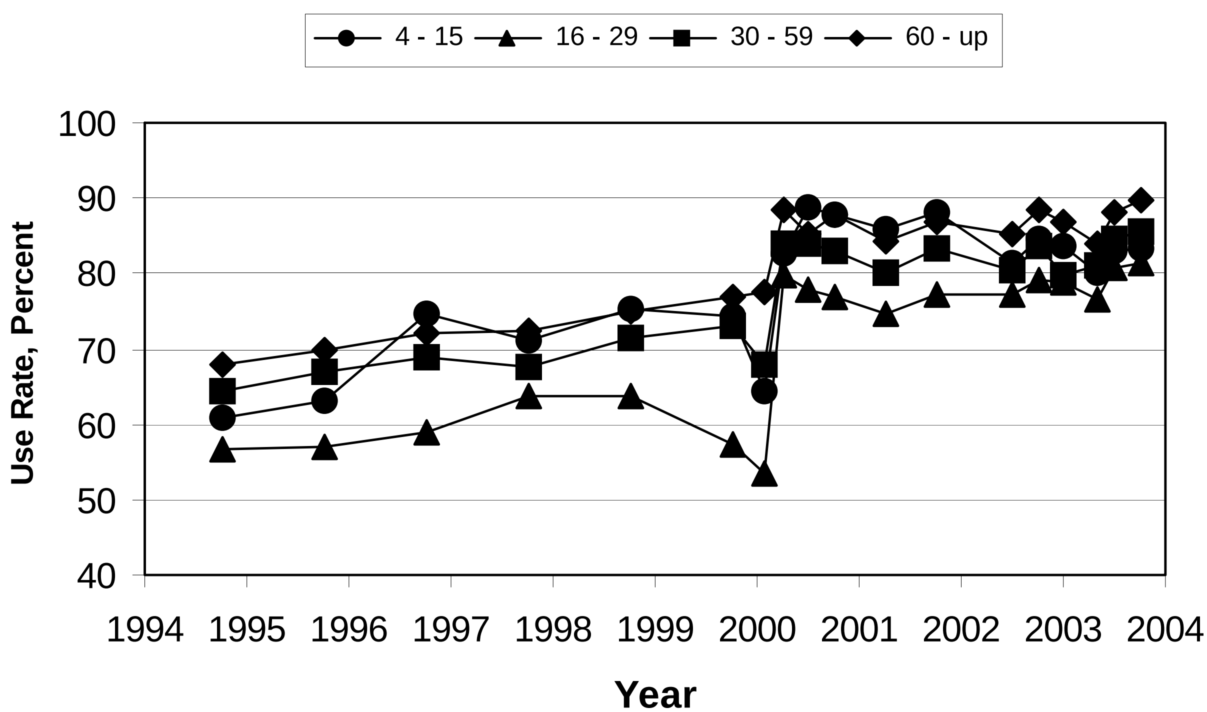

Figure 8. Front-Outboard Shoulder Belt Use by Age and Year (All Vehicle Types Combined).

Belt Use by Vehicle Type and Year. Figure 9 shows motor vehicle occupant belt use by the type of vehicle since 1993. Belt use for 1993 only shows passenger vehicles because only this vehicle type was observed in that year. Figure 9 reveals that significant increases have been observed in safety belt use rates for occupants in all vehicle types. The most notable increase (32.9 percentage points since 1994) has been observed in the belt use rates of pickup truck occupants. However, these occupants continue to be less likely to use a safety belt than occupants of other vehicle types.

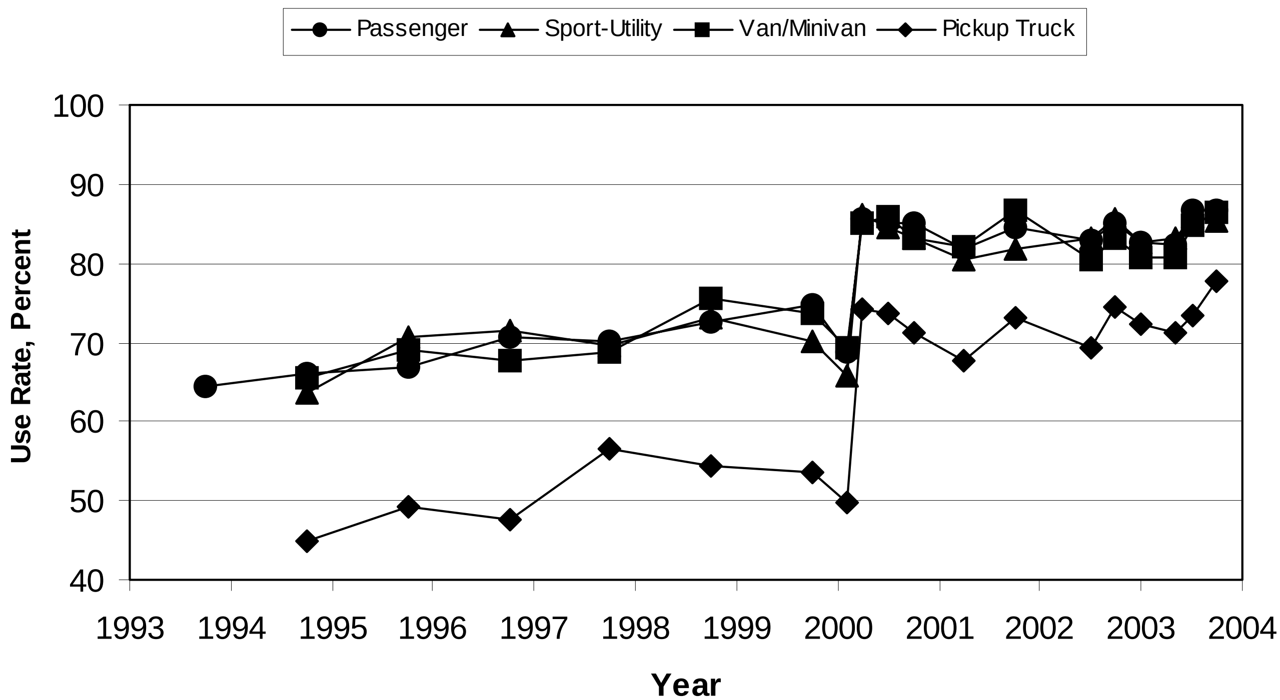

Figure 9. Front-Outboard Shoulder Belt Use by Vehicle Type and Year.

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 84.8 ± 1.6 percent. This rate represents the highest level of statewide safety belt use ever observed in Michigan. Prior to the current survey, the highest belt use rate observed was 83.5 ± 1.3 percent, in March 2000, immediately following the change in Michigan's safety belt use law to primary enforcement (Eby, Fordyce, & Vivoda, 2000). Although the current overall rate is higher than the one observed in March 2000, it is still important to note that statistically, these rates do not differ. A comparison of the current rate to the belt use rate observed exactly one year ago, in September 2002 (Vivoda & Eby, 2002), reveals a similar situation. Although there appears to be an increase of nearly two percentage points, these two belt use rates also do not differ statistically.

However, large statistically significant increases in safety belt use are noted when comparing the rate observed in the current survey to the highest rate observed in Michigan prior to the introduction of primary enforcement. As mentioned previously, this comparison reveals an increase in overall belt use of almost 15 percentage points. Furthermore, the rising trend of safety belt use from 1994 to present (see Figure 3), shows that belt use in Michigan has increased by 22.1 percentage points over these years. These findings indicate the success of several efforts designed to increase safety belt use in Michigan. First, early efforts, such as PI&E programs and increased police enforcement were successful at effecting a gradual increase in belt use. Next, the change to primary enforcement resulted in a marked improvement in safety belt use across the state. Finally, continued efforts to increase safety belt use using media campaigns coupled closely with intensive police enforcement, such as safety belt enforcement zones, continue to be effective in maintaining and further increasing the belt use rate in Michigan.

Comparing results over survey years indicates that much of the overall progress in increasing safety belt use has been made by increasing use among segments of Michigan's population that have traditionally been the least likely to wear safety belts; 16-to-29 year olds, pickup truck occupants, residents of Wayne County, and males. Since the introduction of primary enforcement, safety belt use among each of these groups reflects larger increases than their comparison groups. Belt use among motorists in these groups also reflects the largest increases since 1994. However, even with such increases, and the increases noted in the current survey, these groups continue to display lower belt use than the rest of the motoring public. These results suggest that efforts to increase belt use should continue to focus on these populations. In addition, efforts to understand why these groups wear safety belts less often would be helpful in the development of programs designed to increase safety belt use.

Some progress has been made in understanding differences within the group of 16-to-29 years old motorists. NHTSA has recognized that current traffic safety messages for this age group may not be cognitively appropriate, and has begun an effort to better understand cognitive development and the factors that influence thinking in young drivers (see, e.g., Eby & Molnar, 1999). For instance, arguments should be presented in a positive framework. For example, it is more effective to say, “drive while you are alert and conscientious” than to say “do not drink and drive.” Additionally, young drivers, in particular males, tend to overestimate their driving skills and underestimate the skills of others (optimism bias), and therefore tend to perceive their crash risk as less than that of others; inclusion of peer-group testimonials that address this optimism bias might be effective in overcoming this incorrect reasoning. This information will aid in the development of more appropriate traffic safety messages to continue to increase safety belt use among this age group.

Occupants of pickup trucks also define a unique population in Michigan, and may therefore benefit from specially designed programs. Research has shown that the main demographic differences between the driver/owners of pickup trucks and passenger cars is that driver/owners of pickup trucks are more likely to be male, have higher household incomes, and lower educational levels (Anderson, Winn, & Agran, 1999). This information provides a starting point for the development of programs designed to influence pickup truck occupant safety belt use. Continued efforts to encourage belt use by occupants of pickup trucks are warranted given the low belt use rate of 77.8 percent in the current survey. Conversely, the analysis of safety belt use by the other vehicle types showed that occupants in passenger cars, sport-utility vehicles, and vans/minivans used safety belts at a rate above 85 percent (see Figure 9). A statistical analysis reveals that there is not a significant difference in the safety belt use rates among these vehicle types.

Motorists in Wayne County also tend to wear safety belts less often than people in other areas. One possible explanation for this is that 16.4 percent of people living in Wayne County are living below the poverty level, compared to only 10.5 percent statewide (U.S. Census Bureau, 2000). Additionally, only 77.0 percent of Wayne County residents are high school graduates, while 83.4 percent of Michigan residents have a high school education. Studies have shown that income and level of education are positively correlated with safety belt use (NHTSA, 2000a; Wagenaar, Molnar, & Businski, 1987a). NHTSA (2000b) also reports that safety belt use among African-Americans tends to be lower than belt use by Whites. The population of Wayne County is 42.2 percent African-American, while African-Americans make up only 14.2 percent of the statewide population (U.S. Census Bureau, 2000). These statistics suggest that traffic safety messages focusing on Wayne County may need to present a tailored message to these special populations.

Understanding why there is a difference in belt use between males and females is another critical issue. In the current survey there is a belt use difference of almost 8 percentage points between the sexes. A similar difference has been present in every safety belt survey conducted in Michigan (see e.g., Eby, Molnar, & Olk, 2000; Eby, Vivoda, & Fordyce, 2002). According to the Motor Vehicle Occupant Safety Survey, when safety belt non-users and part-time users were asked why they did not wear belts, males and females gave different reasons (Block, 2000). Males stated “I forgot to put it on” as the most important reason for non-use, while females listed “I’m only driving a short distance” as the reason most important to them. An analysis of the types of answers given by sex revealed that males tend to report non-use for reasons that are related to a lower perception of risk (e.g. low probability of a crash; driving in light traffic), while more of the answers given by female non-users and part-time users are related to discomfort. Traffic safety professionals could use this information for the development of programs aimed at increasing belt use among males.

The study also showed that belt use for drivers has been consistently higher than for passengers, although both have increased. The Motor Vehicle Occupant Safety Survey investigated some of the reasons given for both use and non-use of safety belts by seating position (Block, 2000). Many of the reasons given for both use and non-use of safety belts are the same for both drivers and passengers; there are a few exceptions, however. For example, drivers indicate that they buckle up because "it's a habit" more often than passengers. The belt use of other people in the car is given as a reason for buckling up more often by passengers than drivers. Reasons for non-use are similar, with passengers being less likely to buckle up if others in the vehicle are also not wearing belts. Finally, "traveling only a short distance" is indicated as a reason for non-use by drivers more often than passengers. These concepts along with further research is essential to better understand the dynamics of passenger belt use in order to develop appropriate and effective PI&E programs.

As stated earlier, these low belt use groups are more likely to include a higher percentage of part-time users than other groups. Most of the reasons given by these part-time users for failing to buckle up are related to improper assessment of risk related to specific circumstances. NHTSA (1998b) suggests that the best way to promote belt use to these motorists is to change their perception of risk related to these instances. Using messages in safety belt promotions that attempt to increase anxiety about these situations is suggested as the most effective method. It is generally accepted that these motorists believe in the benefits of safety belts, they just do not perceive the risk as high enough to warrant use of a safety belt (NHTSA, 1998a; NHTSA, 2000c; NHTSA, 2002).

Belt use by the other various subcategories showed the usual trends that have been observed in Michigan over the past 10 years (see e.g., Eby, Molnar, & Olk, 2000; Eby, Vivoda, & Fordyce, 2002). Belt use was higher at exit ramps than at intersections. This difference in use rates has remained relatively consistent over the last 10 years. As discussed by Slovic (1984; see also Eby & Molnar, 1999), this finding may show that people judge whether to use a safety belt on a trip-by-trip basis, and erroneously consider travel on limited-access roadways as less safe than travel on other roadways. Such erroneous reasoning could be addressed in PI&E programs.

Collectively, these findings suggest that PI&E programs, the change in the safety belt law to primary enforcement, and recent mobilization campaigns by the Michigan Department of State Police, Office of Highway Safety Planning, and other local programs, have been effective in increasing belt use in Michigan over the last 10 years. PI&E programs and enforcement campaigns have also been effective in maintaining the high level of belt use observed directly after the change to primary enforcement. The current rate of 84.8 ± 1.6 percent is the highest rate ever observed in Michigan. However, the national and state goal of 90 percent belt use (OHSP, 2002; NHTSA, 1997) requires these efforts to be continued. Programs that promote safety belt use to all of Michigan's population should continue to be applied alongside programs aimed at increasing belt use among the low belt use demographic populations outlined in this report.

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APPENDIX A

Data Collection Forms

SITE DESCRIPTION DO - FALL 2003

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
1a☐ Steve
1b☐ Dave J.
2 ☐ Dave S.
3 ☐ Rich
4 ☐ Paula
5 ☐ Jonathon
6 ☐ Helen
7 ☐ Dave E.
11

DAY OF WEEK
1☐ Monday
2☐ Tuesday
3☐ Wednesday
4☐ Thursday
5☐ Friday
6☐ Saturday
7☐ Sunday
12

WEATHER
1☐ Mostly Sunny
2☐ Mostly Cloudy
3☐ Rain
4☐ Snow
13

START TIME: __ __:__ __ (24 hour clock) (14 15 16 17)   END TIME: __ __:__ __ (24 hour clock) (18 19 20 21)

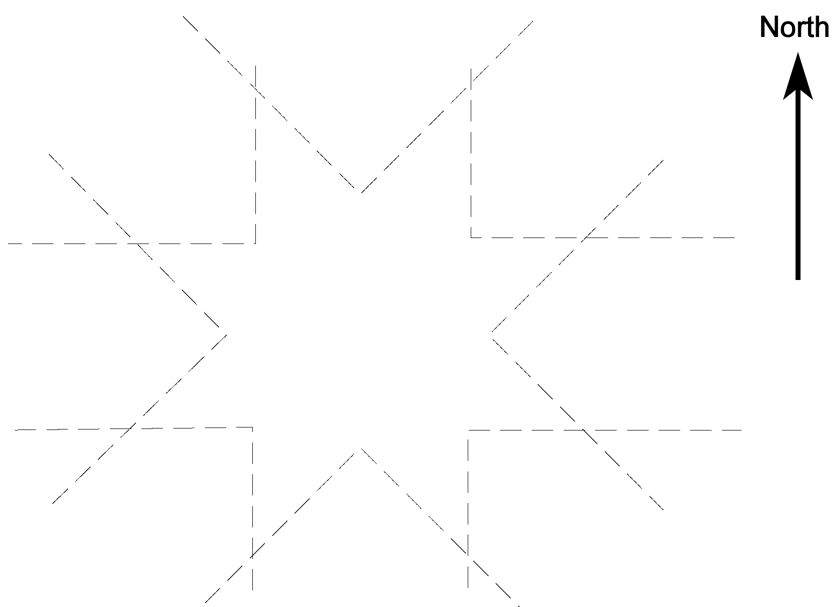
INTERRUPTION (total number of minutes during observation period): __ __ (22 23)

MEDIAN:
1☐ Yes
2☐ No
24

TRAFFIC COUNT 1: __ __ __ (25 26 27)

TRAFFIC COUNT 2: __ __ __ (28 29 30)

COMMENTS:



SITE # ___ ___ ___
1 2 3

ATTENTION CODING: DUPLICATE COL 1 - 3 FOR ALL VEHICLES

DRIVER	1☐ Not belted 2☐ Belted 3☐ B Back 4☐ U Arm 4	1☐ Male 2☐ Female 5	2☐ 4 - 15 3☐ 16 - 29 4☐ 30 - 59 5☐ 60+ 6	VEHICLE TYPE 1☐ Passenger car 2☐ Van 3☐ Utility 4☐ Pick-up 7	
FRONT-RIGHT PASSENGER	1☐ Not belted 2☐ Belted 3☐ B Back 4☐ U Arm 5☐ CRD 8	1☐ Male 2☐ Female 9	1☐ 0 - 3 2☐ 4 - 15 3☐ 16 - 29 4☐ 30 - 59 5☐ 60+ 10	Office Use Only: ___ ___ ___ 11 12 13	COMM. VEHICLE 1☐ No 2☐ Yes 14

DRIVER	1☐ Not belted 2☐ Belted 3☐ B Back 4☐ U Arm 4	1☐ Male 2☐ Female 5	2☐ 4 - 15 3☐ 16 - 29 4☐ 30 - 59 5☐ 60+ 6	VEHICLE TYPE 1☐ Passenger car 2☐ Van 3☐ Utility 4☐ Pick-up 7	
FRONT-RIGHT PASSENGER	1☐ Not belted 2☐ Belted 3☐ B Back 4☐ U Arm 5☐ CRD 8	1☐ Male 2☐ Female 9	1☐ 0 - 3 2☐ 4 - 15 3☐ 16 - 29 4☐ 30 - 59 5☐ 60+ 10	Office Use Only: ___ ___ ___ 11 12 13	COMM. VEHICLE 1☐ No 2☐ Yes 14

DRIVER	1☐ Not belted 2☐ Belted 3☐ B Back 4☐ U Arm 4	1☐ Male 2☐ Female 5	2☐ 4 - 15 3☐ 16 - 29 4☐ 30 - 59 5☐ 60+ 6	VEHICLE TYPE 1☐ Passenger car 2☐ Van 3☐ Utility 4☐ Pick-up 7	
FRONT-RIGHT PASSENGER	1☐ Not belted 2☐ Belted 3☐ B Back 4☐ U Arm 5☐ CRD 8	1☐ Male 2☐ Female 9	1☐ 0 - 3 2☐ 4 - 15 3☐ 16 - 29 4☐ 30 - 59 5☐ 60+ 10	Office Use Only: ___ ___ ___ 11 12 13	COMM. VEHICLE 1☐ No 2☐ Yes 14

DRIVER	1☐ Not belted 2☐ Belted 3☐ B Back 4☐ U Arm 4	1☐ Male 2☐ Female 5	2☐ 4 - 15 3☐ 16 - 29 4☐ 30 - 59 5☐ 60+ 6	VEHICLE TYPE 1☐ Passenger car 2☐ Van 3☐ Utility 4☐ Pick-up 7	
FRONT-RIGHT PASSENGER	1☐ Not belted 2☐ Belted 3☐ B Back 4☐ U Arm 5☐ CRD 8	1☐ Male 2☐ Female 9	1☐ 0 - 3 2☐ 4 - 15 3☐ 16 - 29 4☐ 30 - 59 5☐ 60+ 10	Office Use Only: ___ ___ ___ 11 12 13	COMM. VEHICLE 1☐ No 2☐ Yes 14

APPENDIX B

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	SB M-553/McClellan (CR 553) & M-35	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

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:

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

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 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 x 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, 1998c) stipulate that the relative error of the belt use estimate must be under 5 percent.