2019 ANNUAL DIRECT OBSERVATION SURVEY OF SAFETY BELT USE AND MOBILE DEVICE USE

Prepared for:
Michigan Office of Highway Safety Planning
Lansing, MI

Prepared by:
Michigan State University
East Lansing, MI

Date: July 2019

MICHIGAN OHSP Office of Highway Safety Planning

MICHIGAN STATE UNIVERSITY

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16. Abstract:
This report documents the results of the 2019 Annual Direct Observation Survey of Safety Belt and Mobile Device Use in the State of Michigan. Safety belt use by drivers and front seat passengers was monitored at a total of 200 intersection/interchange sites within 35 counties throughout Michigan during late May and early June 2019. In addition to belt use, data were collected for vehicle type and use, as well as the gender, age, and race for each observed front seat occupant, and mobile device use for each observed driver. The results of this survey show the weighted safety belt usage rate in the state of Michigan for 2019 is 94.4 percent. This represents a 1.0 percent increase from the 93.4 percent use rate observed during the 2018 Annual Direct Observation Survey. Males and younger occupants, specifically those in pick-up trucks, continue to exhibit lower belt use rates. The observed rate of hand-held device use by all vehicle drivers is 7.5 percent, which represents a slight increase from the 7.1 percent device use rate observed during the 2018 Annual Direct Observation Survey.

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1.0 INTRODUCTION

The use of safety belts is perhaps the single most effective means of reducing fatal and non-fatal injuries in motor vehicle crashes. In 2018 alone, a statistical projection estimated 36,750 people were killed in motor vehicle crashes in the United States; only a marginal decrease of 1.0 percent compared with 2017 [1]. Past research indicates that the use of safety belts reduces the risk of fatal injury to front seat occupants by approximately 45 percent for passenger vehicles and 60 percent for light trucks [2]. Moreover, the use of safety belts reduces the risk of moderate to critical injury by 50 percent for occupants of passenger vehicles and 65 percent for the occupants of light trucks [2]. In 2017 alone, safety belts saved approximately 14,955 passenger vehicle occupants over the age of 5 [2]. A recent study conducted by the National Highway Traffic Safety Administration (NHTSA) on the economic and societal impacts of motor vehicle crashes states "The comprehensive societal benefits from safety belt use are enormous" [3]. In fact, this study found that from 1975 to 2010, safety belts have prevented $7.6 trillion in societal harm as measured by comprehensive costs, and are currently preventing $330 billion in societal harm annually [3]. Therefore, even small increases in safety belt use rates may potentially lead to important societal benefits.

In light of these facts, continuing efforts have been aimed at increasing the use of safety belts across the United States. According to a 2018 nationwide safety belt survey, 89.6 percent of drivers and right-front passengers use safety belts, which is a marginal decrease from the 89.7 percent observed in 2017 [4]. The Midwest region as a whole showed an 89.1 percent safety belt use rate in 2018, a slight increase from the 88.6 percent safety belt use rate observed in 2017 [4]. In Michigan, past safety belt use studies indicate the overall use among front seat occupants increased until 2009, prior to a series of gradual declines. Despite these declines, the 2018 use rate was 93.4 percent, indicating the use rate in Michigan is one of 24 states with safety belt use rates higher than 90 percent [5]. It is important to recognize Michigan is currently one of the thirty-four "primary law" states, where a front seat occupant motorist can be stopped and cited for the sole reason of not wearing a safety belt. The most recent available national statistics (2018) indicate that states with primary safety belt laws exhibited an average use rate of 90.6 percent, which is 4.2 percent higher than the 86.4 percent exhibited by states without primary safety belt laws [4].

As the non-use of safety belts is ultimately a behavioral issue, targeted programs aimed at changing belt use behavior of vehicular occupants who are most prone to low belt use rates represent an important tool towards increasing use rates. To that end, identification of demographic characteristics related to low belt use is a primary goal of state belt use surveys. Other uses of state safety belt use include:

- To fulfill reporting requirements to NHTSA;
- To allocate statewide safety funding to specific program areas;
- To provide targeted funding to specific areas within the state where use rates are lower than the statewide average; and
- To provide targeted programs for certain segments of the population.

1.1 Study Purpose and Objectives

The purpose of this study was to perform the Annual Direct Observation Survey at 200 roadside locations to determine the percentage of drivers and front-seat passengers who were utilizing their safety belts correctly and the percentage of drivers using mobile devices. Additional objectives were as follows:

- Implement the methodology for estimating Michigan belt use in an economically feasible manner that is compliant with the Uniform Criteria for State Observational Surveys of Seat Belt Use;
- Provide training to all staff conducting the observation surveys and conduct quality assurance/quality control (QA/QC) of the data collection efforts;
- Conduct an observational survey of safety belt use for two weeks in the month of September;
- Summarize and cross-tabulate the observational data in a spreadsheet format indicating overall safety belt use, safety belt use by strata, safety belt use by time of day and day of week, and safety belt use by various demographic characteristics; and
- Continue to track changes in safety belt use and generate necessary comparative data and analyses to assess the relevancy of the 2019 data and compare results to previous surveys.

1.2 Study Area

The study area for the annual observational survey included those counties representing at least 85 percent of the passenger vehicle fatalities according to Fatality Analysis Reporting System (FARS) data averages for the years 2010 to 2014, which was the data analysis period required for site re-sampling in 2017. Michigan is comprised of 83 counties, 39 of which account for at least 85 percent of the passenger vehicle crash-related fatalities according to FARS data averages for the years 2010 to 2014. Therefore, observation locations from within these 39 counties were eligible to be selected for inclusion in the survey. As required by NHTSA, Michigan will update the sample of data collection sites every five years in order to have survey results that represent the geographic areas with at least 85 percent of crash-related fatalities.

2.0 SAMPLING METHOD

In 2011, the National Highway Traffic Safety Administration (NHTSA) issued new Uniform Criteria for State Observational Surveys of Seat Belt Use in *Federal Register Vol. 76, No. 63* (April 1, 2011, Rules and Regulations, pp. 18042 – 18059). The current methodological approach was prepared for the State of Michigan as a part of the 2013 direct observation safety belt survey and was subsequently approved by NHTSA. The methodology was employed during the sampling of locations used in the surveys performed during the five-year period of 2013 through 2017. However, the federal criteria also requires that states re-sample the observation locations using the approved methodology at least every five years. Thus, the 200 primary and 200 alternative observation sites were re-sampled for the 2018-2022 state of Michigan safety belt surveys. This re-sampling task was performed by Michigan State University based on the NHTSA-approved methodology for the state of Michigan (developed in 2013), using updated FARS and vehicle

miles traveled (VMT) data. The methodology and lists of 200 primary and 200 alternative sites for the 2018-2022 surveys were approved by NHTSA in early 2018. Please refer to Appendix II for the resumes of the principal investigators, Dr. Timothy Gates and Dr. Peter Savolainen, who in addition to leading the re-sampling effort for the FY2018-2022 surveys, also led development of the methodological approach for the state of Michigan as a part of the FY 2013 safety belt survey. The following sections provide details of the sampling process.

2.1 General Approach

The study approach includes a stratified systematic probability proportional to size (PPS) sample of data collection sites as described here:

1. All 83 counties in Michigan were listed in descending order of the average number of motor vehicle crash-related fatalities for the period from 2010 to 2014. FARS data were used to determine the average number of crash-related fatalities per county. It was determined 39 counties accounted for at least 85 percent of Michigan's total crash-related fatalities during this period as shown in Table 1. These 39 counties comprise the sample frame.

2. The counties were stratified according to historical safety belt use rates into four strata. These strata were constructed such that the annual vehicle miles of travel (VMT) were approximately balanced within each of the four groups. This represents the first stage of sample selection.

3. At the second stage, the MAF/TIGER Feature Class Code (MTFCC, see Section 2.2) was used to classify all road segments into three explicit classifications: 1.) Primary Roads, 2.) Secondary Roads, and 3.) Local Roads. This resulted in a total of 12 strata (4 belt use strata, each with 3 MTFCC classes). The number of sites within each MTFCC class was determined proportionately based upon historical VMT, resulting in 30 percent primary roads, 60 percent secondary roads, and 10 percent local roads.

4. Road segments were then implicitly stratified by county and segment length. Specific segments were selected randomly with PPS from all segments within each stratum. A random, systematic sample of 50 road segments was selected PPS to road segment length within each belt use group. This process resulted in the selection of 200 road segments (4 belt use rate groups x 50 sites per belt use rate group, allocated proportionately among MTFCC classes). An additional 200 sites were also selected to use as alternates. Figure 1 shows a map displaying the 35-county sample for the annual direct observation safety belt survey.

5. It was initially expected each site would result in a sample size of approximately 125 vehicles, resulting in approximately 25,000 vehicle observations overall based upon past experience with the Michigan Annual Safety Belt Use Study. Based on these figures, the standard error was expected to be less than 2.5 percent. In the event the calculated standard error should be greater than 2.5 percent, additional data would be collected from existing sites until this criterion was satisfied.

6. Additional stages of selection were used to determine travel direction, lane, day of week, time of day, and vehicles to be observed, at random and with known probability, as appropriate under the Uniform Criteria, as described in Section 2.4.

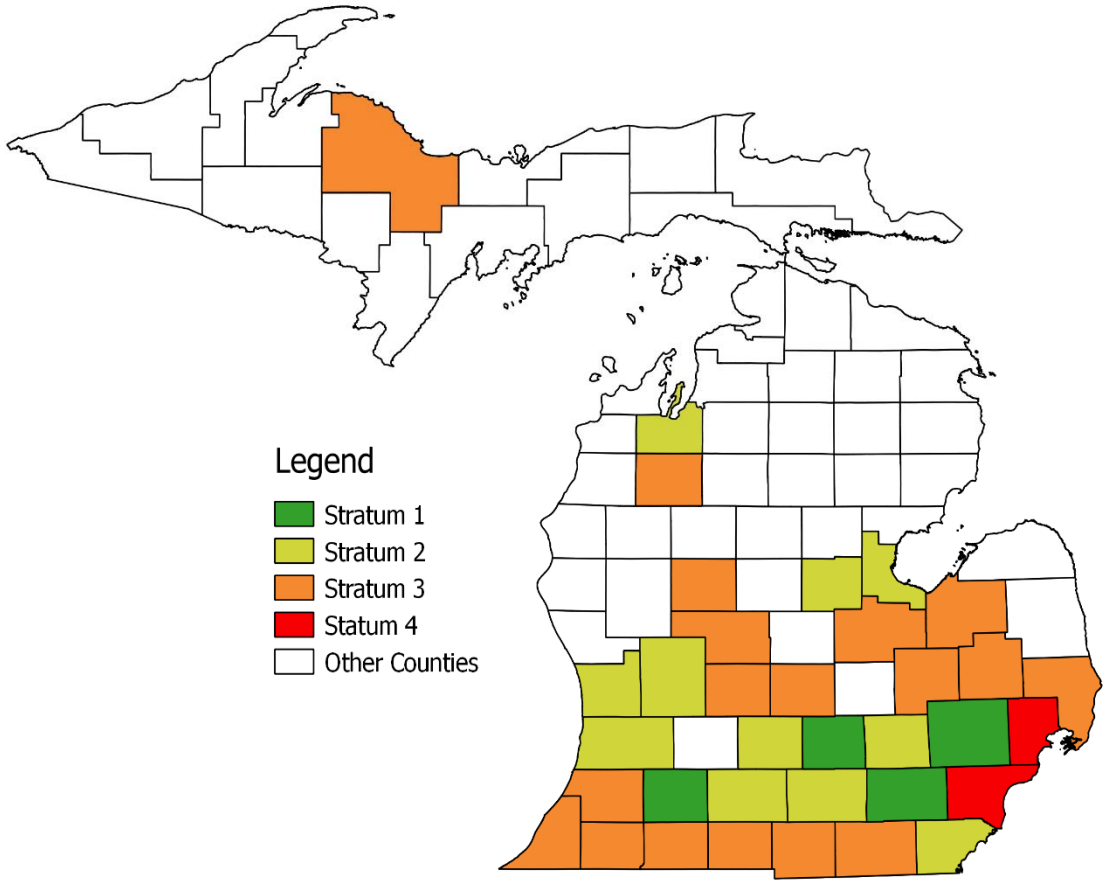

Figure 1: 35-County Sample for the Direct Observation Safety Belt Surveys

Table 1. Michigan Average Motor Vehicle Crash-Related Fatalities by County (2010-2014)

County	Average Annual Fatalities (FARS)	Fatality Percentage Within Michigan	Cumulative Fatality Percentage
WAYNE	158.0	16.9%	16.9%
OAKLAND	60.6	6.5%	23.3%
KENT	50.4	5.4%	28.7%
MACOMB	48.8	5.2%	33.9%
GENESEE	36.2	3.9%	37.8%
WASHTENAW	28.2	3.0%	40.8%
MONROE	26.4	2.8%	43.6%
KALAMAZOO	25.4	2.7%	46.3%
BERRIEN	20.8	2.2%	48.5%
SAGINAW	20.4	2.2%	50.7%
INGHAM	19.4	2.1%	52.8%
ST. CLAIR	18.6	2.0%	54.8%
OTTAWA	18.0	1.9%	56.7%
LIVINGSTON	17.2	1.8%	58.5%
MUSKEGON	16.8	1.8%	60.3%
JACKSON	16.6	1.8%	62.1%
CALHOUN	14.4	1.5%	63.6%
ALLEGAN	14.0	1.5%	65.1%
BAY	13.4	1.4%	66.5%
LENAWEE	13.2	1.4%	67.9%
VAN BUREN	12.8	1.4%	69.3%
GRAND TRAVERSE	11.4	1.2%	70.5%
EATON	10.6	1.1%	71.6%
BARRY	10.2	1.1%	72.7%
MONTCALM	9.8	1.0%	73.8%
LAPEER	9.6	1.0%	74.8%
ST. JOSEPH	9.6	1.0%	75.8%
CASS	9.2	1.0%	76.8%
TUSCOLA	9.2	1.0%	77.8%
IONIA	9.0	1.0%	78.8%
ISABELLA	8.2	0.9%	79.6%
NEWAYGO	7.8	0.8%	80.5%
CLINTON	7.3	0.8%	81.2%
HILLSDALE	7.2	0.8%	82.0%
MIDLAND	7.2	0.8%	82.8%
WEXFORD	7.0	0.7%	83.5%
MECOSTA	6.8	0.7%	84.2%
BRANCH	5.8	0.6%	84.9%
MARQUETTE	5.8	0.6%	85.5%

2.2 Road Segment Stratification

Using 2016 Topologically Integrated Geographic Encoding and Referencing (TIGER) data developed by the U.S. Census Bureau, a comprehensive list of road segments from within these 39 counties was created. Each of these road segments has been classified by the U.S. Census Bureau using the MAF/TIGER Feature Class Code (MTFCC). There are primarily three classifications: 1) Primary Roads, 2) Secondary Roads, and 3) Local Roads (See Table 2 for detailed definitions). In addition, the listings include segment length as determined by TIGER. This descriptive information allowed for stratification of road segments. A systematic probability proportional to size (PPS) sample was employed to select the road segments to be used as observation sites.

Table 2. Michigan MAF/TIGER Feature Class Code Codes Included in the Road Segment File

Code	Name	Definition
S1100	Primary Road	Primary roads are generally divided, limited-access highways within the interstate highway system or under state management, and are distinguished by the presence of interchanges. These highways are accessible by ramps and may include some toll highways.
S1200	Secondary Road	Secondary roads are main arteries, usually in the U.S. Highway, State Highway, or County Highway system. These roads have one or more lanes of traffic in each direction, may or may not be divided, and usually have at-grade intersections with many other roads and driveways. They often have both a local name and a route number.
S1400	Local Neighborhood Road, Rural Road, City Street	These are generally paved non-arterial streets, roads, or byways that usually have a single lane of traffic in each direction. Roads in this feature class may be privately or publicly maintained. Scenic park roads would be included in this feature class, as would (depending on the region of the country) some unpaved roads.

2.3 Selection of Road Segments

Within each of the four belt use strata, a total of 50 road segments were selected. Michigan employed the Census TIGER EDGES data set for the selection of road segments. Michigan exercised the available exclusion option and removed rural local roads in counties not within metropolitan statistical areas (MSAs), and other non-public roads, unnamed roads, unpaved roads, vehicular trails, access ramps, cul-de-sacs, traffic circles, and service drives from the dataset. The number of road segments selected within each MTFCC class was determined proportionately based upon total annual VMT within the three classes (Primary, Secondary, and Local). Thus, the segments selected ultimately included 15 primary roads (20 percent of sample), 30 secondary roads (60 percent of sample), and 5 local roads (10 percent of sample).

Prior to selecting the specific observation locations, all road segments were explicitly stratified by MTFCC (primary, secondary and local) within each of the four belt use rate groups and implicitly stratified by county and by segment length to obtain an ordered list. Implicit stratification by county was done to ensure adequate geographic coverage was obtained as a part of the selection process. Similarly, the implicit

stratification by length ensured representative coverage within each MTFCC class since higher-class roads tended to be longer than lower-class roads. Specific road segments were then selected with PPS using segment length as the measure of selection (MOS). As such, the inclusion probability for a specific road segment is:

$$\pi_{h|gc} = n_{gc} l_h / \sum_{\forall h} l_h,$$

where $n_{gc}$is the road segment sample size for MTFCC *c* in stratum g that was allocated, l_h is the length of road segment h, and

$$\sum_{\forall h} l_h$$

is the total length of all segments in stratum g and MTCFF *c*.

A random start (RS) was selected between 0 and the calculated *I*, which determined the first road segment selected. Subsequent road segments selected were determined by adding multiples of *I* to the RS until the desired number of road segments were selected and/or the end of the sorted list was reached.

Table 3 presents summary statistics detailing the number of eligible road segments (N), the total length (miles) of these segments, and the number of road segments selected (n) within each of the MTFCC classes by belt use group and county. Appendix III presents the complete list of the final observation sites including belt use stratum, county, and road classification.

In the event an original road segment was permanently unavailable, a reserve road segment was to be used. The reserve road segment sample consisted of one additional road segment per original road segment selected, resulting in a reserve sample of an additional 200 road segments. These reserve segments were identified and selected as the road segments immediately following the original road segment actually selected. Thus, these segments were also explicitly stratified by safety belt use and MTFCC group, as well as implicitly stratified by segment length and county. Each reserve segment corresponded to an original road segment actually selected. Thus, these are considered selected with PPS using road segment length as MOS by the same approach as described previously. As such, for the purposes of data weighting, the reserve road segment inherited all probabilities of selection and weighting components up to and including the road segment stage of selection from the original road segment actually selected. Probabilities and weights for any subsequent stages of selection (e.g., the sampling of vehicles) would be determined by the reserve road segment itself.

Table 3. Roadway Functional Strata by County, Road Segments Population (N), Length of Selected Segments (miles), and Number of Segments Selected (n)

Stratum	County	Type	MTFCC Classification			
			Primary	Secondary	Local	Total
Stratum 1	Ingham	N	272	1203	15017	16492
		Length	63	158	1967	2189
		n	3	8	0	11
	Kalamazoo	N	160	729	14749	15638
		Length	50	123	2023	2196
		n	2	5	0	7
	Oakland	N	792	1907	65290	67989
		Length	164	234	6804	7203
		n	7	8	3	18
	Washtenaw	N	282	910	18992	20184
		Length	66	162	2614	2842
		n	3	9	2	14
Stratum 2	Allegan	N	170	614	11226	12010
		Length	58	131	2249	2438
		n	2	4	0	6
	Bay	N	200	726	8954	9880
		Length	57	120	1363	1539
		n	1	2	0	3
	Calhoun	N	388	775	10407	11570
		Length	120	104	1848	2072
		n	4	0	1	5
	Eaton	N	255	714	7584	8553
		Length	78	129	1457	1664
		n	3	3	0	6
	Grand Traverse	N	0	604	8996	9600
		Length	0	105	1325	1430
		n	0	2	0	2
	Jackson	N	215	827	11597	12639
		Length	61	154	1942	2157
		n	3	6	1	10
	Kent	N	438	1524	33635	35597
		Length	88	266	3911	4265
		n	0	7	1	8
	Livingston	N	239	523	14418	15180
		Length	61	104	2043	2209
		n	1	1	1	3
	Midland	N	0	461	7172	7633
		Length	0	97	1282	1379
		n	0	2	0	2
	Monroe	N	324	740	10324	11388
		Length	68	133	1676	1877
		n	0	2	1	3
	Ottawa	N	205	819	15925	16949
		Length	70	135	2239	2445
		n	1	1	0	2
Stratum 3	Berrien	N	447	1059	15481	16987
		Length	103	168	2051	2321
		n	2	1	0	3
	Branch	N	108	287	5159	5554
		Length	45	52	1219	1316
		n	1	0	0	1
	Cass	N	0	649	5870	6519
		Length	0	127	1186	1313
		n	0	2	1	3

Table 3 - Roadway Functional Strata by County, Road Segments Population (N), Length of Selected Segments (miles), and Number of Segments Selected (n) (Continued)

Stratum	County	Type	MTFCC Classification			
			Primary	Secondary	Local	Total
Stratum 3	Clinton	N	188	369	6505	7062
		Length	56	98	1387	1540
		n	0	2	0	2
	Genesee	N	664	802	24988	26454
		Length	139	136	2918	3193
		n	2	3	0	5
	Hillsdale	N	0	488	5533	6021
		Length	0	113	1365	1478
		n	0	1	0	1
	Ionia	N	164	391	6229	6784
		Length	51	78	1334	1463
		n	0	2	0	2
	Lapeer	N	159	382	7611	8152
		Length	49	80	1618	1747
		n	1	1	1	3
	Lenawee	N	0	878	2672	3550
		Length	0	162	264	425
		n	0	2	0	2
	Marquette	N	0	897	8662	9559
		Length	0	184	1639	1822
		n	0	3	0	3
	Mecosta	N	0	446	6597	7043
		Length	0	108	1398	1506
		n	0	1	0	1
	Montcalm	N	0	616	8736	9352
		Length	0	132	1842	1975
		n	0	2	2	4
	Saginaw	N	307	1047	15814	17168
		Length	61	170	2390	2621
		n	3	1	0	4
	St. Clair	N	388	865	11924	13177
		Length	107	107	1987	2201
		n	2	0	0	2
	St. Joseph	N	0	831	6885	7716
		Length	0	140	1277	1417
		n	0	1	1	2
	Tuscola	N	0	651	408	1059
		Length	0	141	39	180
		n	0	2	0	2
	Van Buren	N	198	450	8193	8841
		Length	75	85	1618	1777
		n	4	4	0	8
	Wexford	N	0	680	5235	5915
		Length	0	155	1119	1274
		n	0	2	0	2
Stratum 4	Macomb	N	402	1651	39648	41701
		Length	65	159	3745	3970
		n	3	14	3	20
	Wayne	N	2041	3860	85981	91882
		Length	250	292	7620	8161
		n	12	16	2	30

2.4 Selection and Scheduling of Survey Locations

Road segments were mapped according to the latitude and longitude of their midpoints. The selected road segment was identified by an intersection or interchange that occurred within or just beyond the segment. Data collection sites were deterministically selected such that traffic would be moving during the observation period. Therefore, sites were assigned to locations within the segment that were 50 to 150 feet from any controlled intersections. For limited access roadways, data collection occurred on a ramp carrying traffic exiting the highway. The observed direction of travel was randomly assigned for each road segment.

All belt use observations were conducted during weekdays and weekends between 7 AM and 7 PM to include rush hour (before 9:30 AM and after 3:30 PM) and non-rush hour observations. Site assignment schedules, which were provided to the data collectors and quality control monitors, indicated the observed road name, nearest crossroad, GPS coordinates where the observer should stand, assigned date, assigned time, and assigned observation direction. Sites within relatively close geographic proximity were assigned as data collection clusters. In accordance with the uniform safety belt survey criteria, the first site within each cluster was assigned a random day and time for completion. All other sites within a cluster were assigned to the same day and by geographic proximity to minimize travel within the cluster. Approximately five sites were scheduled each day for each data collector. Start times and days were staggered to ensure all days of the week and hours of the day (daylight) were represented in the sample.

2.5 Data Collection Process

Safety belt surveys were performed for exactly 60 minutes at each of the 200 observation locations. Wayne State University (WSU), under subcontract to MSU, collected data at those study sites in Wayne, Oakland, Macomb, and Monroe Counties, while MSU collected data at all other locations. The data collected at the 200 observation sites provided a representative sample for each day of the week and each hour of the day between 7 AM and 7 PM of the statewide safety belt use characteristics. All passenger vehicles, including commercial vehicles weighing less than 10,000 pounds, were eligible for observation. Heavy truck, buses, and other vehicles weighing over 10,000 pounds were not observed. Only one direction of traffic was observed at any given site. The data collectors were instructed to observe as many lanes of traffic as they could while obtaining data on 99 percent of eligible vehicles. This direction of observation was pre-determined at each location as explained previously. The observations were appropriately weighted, as explained in the Data Analysis Section of this report (Section 5.0).

The observers carried a cover sheet and numerous safety belt observation data collection paper forms to each site. These forms are shown in Appendix I. The observation form was used to record safety belt use by drivers and front seat passengers, including children in booster seats. The only front seat occupants excluded from this study were children seated in child seats with harness straps. Table 4 lists the three clearly defined categories of safety belt use that were observed by the data collectors, which included

'belted correctly', 'not belted correctly', and 'unknown belt use' as previously described. An occupant was recorded as 'belted correctly' only if they were observed to be properly using the shoulder belt (i.e. shoulder belt was across chest; not under arm or behind back). The 'unknown belt use' category was marked if an observer was unable to determine the position of an occupant's safety belt, and these observations were not included in the final sample but a record was kept to calculate the non-response rate which is discussed in the data analysis section of this report.

Table 4. Safety Belt Use Codes and Definitions

Code	Definition
Belted	The shoulder belt is in front of the person's shoulder and used correctly.
Not belted	The shoulder belt is not in front of the person's shoulder or not used at all.
Unknown	It cannot reasonably be determined whether the driver or right front passenger is belted.

Additional data collected for each observed front-seat occupant included occupant age (estimated), gender, and race, as well as vehicle type and use (e.g. commercial or non-commercial) information. The driver age categories included 16-29, 30-59, 60 and over, and unknown, while the passenger age also included a 0-15 category. The driver and passenger race categories included white, black, other, or unknown. Each observed vehicle was categorized into one of four groups: passenger cars, sport utility vehicles, vans or minivans, and pick-up trucks. The vehicles were also identified as commercial or non-commercial vehicles. Furthermore, the driver was also observed for any indication of mobile device use. The categories included 'hand-held (talking)', 'hand-held (typing)', 'hands-free (ear piece)', and hands-free (no ear piece)'.

The cover sheet was used to document site information, including: date, site location, site number, alternate site data, assigned traffic flow, number of lanes available and observed, start and end times for observations, and weather conditions. This cover sheet was completed by the data collector at each site before any observations took place.

Observations were manually recorded in the field on survey forms and returned back to the office within 24 hours of the data collection, or as soon as possible after multiple day trips to outstate locations. The data collected in the field were entered into a spreadsheet by the observer at the conclusion of the data collection activities for each day and verified for accuracy in the office by office staff.

Data collectors also used a hand-held tally device to simultaneously count every passenger vehicle that passed through the observed lanes during the 60-minute observation period, regardless of whether a safety belt observation was performed. This volume count was then utilized during the belt use weighting process.

2.6 Rescheduling and Alternate Sites

If a site was temporarily unavailable due to a crash, short-term road work or maintenance, inclement weather, or any event that may hinder exact results, data collection was rescheduled for a similar time of day and type of day of the week. In the event the site was permanently unavailable, such as being located within a gated community or closed for long-term construction, then an alternate site selected as part of the reserve sample was to be used as a permanent replacement.

2.7 Sample Size and Precision

A standard error of less than 2.5 percent for the safety belt use estimates is required by the Final Rule. Since 1999, Michigan has conducted the Michigan Annual Safety Belt Use Study, and has historically obtained standard errors below this threshold (e.g. most recently 0.4 percent in 2018) via observed sample sizes of approximately 25,000 vehicles. Since the proposed design for the 2019 Annual survey was similar to the 2018 survey, it was expected that the sample size for the 2019 Annual Survey would be similar to the 2018 Annual Survey and the precision objective was expected to be achieved. In the event that the precision objective was not met, additional observations would be taken starting with those sites having the fewest observations. New data would be added to existing data until the desired precision was achieved.

3.0 OBSERVER TRAINING

The data collection team was comprised of MSU and WSU student staff, many of whom have participated in prior safety restraint use surveys. All data collectors were able to stand for long periods of time, work outdoors, and successfully complete the training program. The data collector training program included both a classroom and field portion. The classroom training program was conducted at MSU approximately three weeks prior to the start of the survey and was led by the PI, Timothy Gates. All data collectors from both MSU and WSU attended this classroom session. Each data collector received a training manual composed of the information detailed during the training session and all necessary field supplies. The syllabus for the training program is shown as Figure 2.

At the conclusion of the classroom training, the data collectors conducted their first field practice at a location near the MSU campus. QC monitors were available during this period to respond to questions and offer assistance to data collectors as needed. Reliability and repeatability field data collection practice continued during the weeks leading up to full-scale survey implementation at various intersections near the MSU and WSU campuses. These intersections represented various site characteristics that could be challenging for observational data collection. Initially, inexperienced observers were paired with experienced observers, who noted which individual vehicle the entire group was to evaluate. This allowed an analysis of the accuracy of the inexperienced data collectors in comparison to those who have participated in the study previously. After gaining ample experience, observers were then randomly divided

into groups and assigned to collect safety belt observational data independently. The training data was then entered and compared among the observers in each group to determine the accuracy of their observations.

Day 1 – In-Class Training Program and Field Practice

Welcome, introductions, and distribution of materials

Survey overview

Scheduling and rescheduling
- Site Assignment Sheet
- Observation periods
- Temporary impediments such as weather
- Permanent impediments at data collection sites

Site locations
- Locating assigned sites
- Alternate site selection
- Interstate ramps and surface streets
- Direction of travel/number of observed lanes

Data collection techniques
- Definitions of belt/booster seat use, passenger vehicles
- Observation protocol: belt use, vehicle type/use, demographic characteristics
- Unobservable vehicles/occupants

Data collection forms
- Cover sheet
- Recording alternate site information
- Recording observations

Data entry procedures

Travel reports, lodging, and auto reservations

Field practice at ramps and surface streets

Days 2-10 Continued Field Practice

Field practice at ramps and surface streets

Figure 2. Training Syllabus

4.0 QUALITY CONTROL

The policies and procedures utilized while conducting the direct observation surveys of safety belt use were based upon the *Uniform Criteria for State Observational Surveys of Seat Belt Use* from Title 23, Part 1240.12 of the Code of Federal Regulations. The study design for the Annual Survey was consistent with these criteria, which established observations should be conducted on specific dates and times and in particular directions of travel, all of which were determined randomly in advance of the studies. Further, the criteria state policies should be in place in the event observations cannot be made due to unanticipated events, such as road construction. In such situations, data collectors were instructed to observe at the pre-assigned alternate location. Policies were also established for cases where traffic flow is too heavy to observe all vehicles or traffic is moving too quickly for observation. In most instances, high traffic volumes prohibit data collectors from observing all vehicles. Consequently, data collectors were instructed to observe as many vehicles as is feasible for observation under such conditions for the required time period of 60 minutes, although all passenger vehicles traveling through the observed lanes during the data collection period were included in the volume count.

The principal investigators from MSU and WSU served as the QC monitors, conducting site audits of the data collectors. The QC monitor made unannounced covert visits to five percent of all data collection sites over the duration of the study, which amounted to 10 sites. The purpose of these visits was to ensure data collectors were following all survey protocol including: performing observational surveys at the assigned location, in the assigned direction, during the assigned time period, completing the cover sheet and observation forms correctly, making accurate observations of safety belt use within an appropriate number of lanes. The random checks were conducted at least once for each observer and no major violations of policies or procedure were observed as a part of these audits. The QC monitors also checked a 10 percent random sample of the entered data to ensure the observation data were being entered correctly from the data collection forms. After data entry, all forms were organized, boxed, and stored for 3-years.

5.0 DATA ANALYSIS

The data collected in the field as a part of the 35-county annual survey were entered into a spreadsheet by the observer at the conclusion of the data collection activities for each day and verified for accuracy by office staff. Rates for safety belt and mobile device use were determined for each survey stratum, county, location, etc., as well as the statewide annual average. A 95-percent confidence interval for each use rate estimate was determined according to the NHTSA guidelines. The following sections outline the methods used to estimate the use rate and variance for safety belts. A similar procedure was utilized to estimate mobile device use rate and variance.

5.1 Imputation

No imputation was done on missing data.

5.2 Sampling Weights

The following is a summary of the notation used in this section.

g – Subscript for belt use group strata

h – Subscript for road segment strata

i – Subscript for road segment

j – Subscript for time segment

k – Subscript for road direction

l – Subscript for lane

m – Subscript for vehicle

n – Subscript for front-seat occupant

Under this stratified multistage sample design, the inclusion probability for each observed vehicle was the product of selection probabilities at all stages: π_g for belt use group (stratum-road class), $\pi_{hi|g}$ for road segment, $\pi_{j|ghi}$ for time segment, $\pi_{k|ghij}$ for direction, $\pi_{l|ghijk}$ for lane, and $\pi_{m|ghijkl}$for vehicle. So the overall vehicle inclusion probability was:

$$\pi_{ghijklm} = \pi_g \pi_{hi|g} \pi_{j|ghi} \pi_{k|ghij} \pi_{l|ghijk} \pi_{m|ghijkl}.$$

The sampling weight (design weight) for vehicle *m* is:

$$w_{gchijklm} = \frac{1}{\pi_{gchijklm}}$$

5.3 Non-Responding Site Adjustment

There were no sites which required 'non-responding' adjustment in the 2019 Annual Direct Observation Survey of Safety Belt Use. It should be noted that no observations were recorded at site number 52 (S. County Line Road and Blackner/O'Brien Road in Montcalm County), however since there were no 'vehicle not observable' or 'unknown belt use' observations here, no non-responding adjustment is required as per *An Example of a Compliant State Seat Belt Use Survey Design* [6].

5.4 Estimators

Noting all front-seat occupants were observed, the driver/passenger safety belt use status was:

$$y_{ghijklmn} = \begin{cases} 1, if\ belt\ used \\ 0, otherwise \end{cases}$$

In order to most accurately estimate the weighted safety belt use rate for the entire state of Michigan, the estimator used in this analysis was weighted by segment length and stratum-level VMT to determine the overall annual belt use rate in Michigan. This estimation technique is detailed in *An Example of a Compliant State Seat Belt Use Survey Design* [6]. Under this estimator, the use rates within each stratum were first calculated using the road segment length based estimator:

$$p_{L_{gh}} = \frac{\sum_{all\ ijklmn\ in\ gh} w_{ijklm|gh} Length_{ghi} y_{ghijklmn}}{\sum_{all\ ijklmn\ in\ gh} w_{ijklm|gh}\, Length_{ghi}}$$

The twelve stratum-specific use rates were then weighted by the proportion of total statewide VMT (shown in Table 5) within each stratum, which resulted in the road class VMT-based estimator (p_{VMT}):

$$p_{VMT} = \frac{\sum_g w_g \sum_h VMT_{gh} p_{gh}}{\sum_g w_g \sum_h VMT_{gh}}$$

Table 5. Annual Vehicle Miles of Travel by Stratum, 2017 (in 1,000s)

Belt Use Stratum	Road Class			Total
	Primary	Secondary	Local	
1	8,119,622	11,650,398	2,232,329	22,002,349
2	8,492,722	12,290,750	1,806,166	22,589,638
3	5,828,661	11,912,007	1,970,787	19,711,455
4	7,967,017	12,041,046	2,200,137	22,208,200
Statewide	30,408,022	47,894,201	8,209,419	86,511,642

The use of the VMT-based estimator (p_{VMT}) reduced the weighting bias towards local road observation sites by accounting for their relatively short length and low VMT as compared to primary and secondary roads. VMT data were obtained from the Michigan Highway Performance Monitoring System (HPMS) for the year 2017.

5.5 Variance Estimation

The variance (and standard error) for each estimator was determined using the "Delete-1 Jackknife" variance estimation program in SUDAAN 11 software. Under this methodology, the variance was calculated by deleting one observation location and adjusting the weights of the remaining PSU's in the same stratum to account for the deleted PSU. The procedure was repeated, removing each location once. For the road class VMT based estimator (p_{VMT}), the "Delete-1 Jackknife" method was used to estimate the variances within each of the road class/belt use strata:

$$V(p_{gh}) = \left(\frac{n_{gh} - 1}{n_{gh}}\right) \sum_{i=1}^{n_{gh}} (p_{ghi} - p_{gh})(p_{ghi} - p_{gh})'$$

where:

$V(p_{gh})$ = Estimated variance within each of the road class/belt use strata

$\boldsymbol{p}$ = Estimated belt use rate

$\boldsymbol{p_{ghi}}$ = Estimated belt use rate at location *i* in road segment type *h* in belt use group *g*

$\boldsymbol{p_{gh}}$ = Estimated belt use rate in road segment type *h* in belt use group *g*

$\boldsymbol{n_{gh}}$ = Number of locations of road segment type *h* in belt use group *g*

The variance for the annual use rate was then determined using the following equation:

$$V(p) = \frac{\sum_{\forall g, \forall h} VMT_{gh}^2 V(p_{gh})}{\left(\sum_{\forall g, \forall h} VMT_{gh}\right)^2}$$

where:

$\boldsymbol{V(p)}$ = Estimated variance of statewide belt use rate

The standard error of the statewide use rate was found by simply taking the square root of the estimated variance. The 95 percent confidence interval of the statewide belt use was equal to the weighted safety belt use rate plus/minus 1.96 (for the Z-test at alpha = 0.05) multiplied by the standard error expressed as a percent.

5.6 Non-Response Rate

According to NHTSA's guidelines, the non-response rate for the annual safety belt survey cannot exceed 10 percent. A non-response occurs when the observer was not able to determine the safety belt use of a front seat vehicle occupant. This can occur due to a variety of reasons such as tinted windows, sun glare, high speeds of the vehicle in question, etc. Observers in the field marked either 'vehicle not observable' or 'unknown belt use' to keep a record of the non-response rate. There were a total of 349 non-response observations which represents approximately 1.8 percent of the total number of observations. This non-response rate was below the allowable maximum of 10 percent established by the NHTSA.

6.0 RESULTS AND CONCLUSIONS

The Annual Direct Observation Survey was performed between Tuesday, May 28, and Monday, June 17, 2019. During this observation period, a total of 15,692 vehicles were observed resulting in 19,474 driver and right-front passenger observations at the 200 observation sites randomly selected to represent statewide safety belt use according to the federal Uniform Criteria.

6.1 Safety Belt Survey Results and Conclusions

The overall weighted annual safety belt use rate for Michigan in 2019 was found to be 94.4 percent and is shown in Table 6. The overall weighted annual safety belt use rate was calculated based upon the procedure described in the Data Analysis section (Section 5.0) of this report. When the safety belt usage rates were calculated, belted occupants included all drivers and front-seat passengers who were belted correctly. The "not belted" occupants included drivers and front-seat passengers who were not belted or who were wearing the belt incorrectly; either under their arm or behind their back. Details of the observations on an intersection level are provided in Appendix III.

Table 6. Annual Weighted Safety Belt Use Rate for Drivers and Front-Seat Passengers

Observational Wave	Safety Belt Use Rate*	Standard Error
Annual	94.4% ± 1.0%	0.5%

* Weighted Safety Belt Usage ± 95% Confidence Band

The overall annual use rate displayed in Table 6 is representative of all front seat occupants (drivers and right-front passengers), all daytime hours (7:00 AM-7:00 PM) and all days of the week. Table 7 shows the raw (unweighted) safety belt use information separated by drivers and front-right passengers. Table 8 summarizes the descriptive statistics for the safety belt survey in terms of sampling statistics for day of the week and time of the day.

Table 7. Annual Raw/Unweighted Safety Belt Use Summary

Belt Use	Actual Total No. of Observations	Actual Belted No. of Observations	% Safety Belt Use
Drivers	15,667	14,712	93.9%
Passengers	3,807	3,611	94.9%
Total	**19,474**	**18,323**	**94.1%**

Table 8. Annual Safety Belt Use Day and Time Sampling Summary

Day of the Week	Annual Safety Belt Observations			
	No. of Sites Observed	Percent of Sites in Day of Week	Actual Total No. of Observations (Occupants)	Percent of Observations in Day of Week (Occupants)
Sunday	21	10.5%	2,501	12.8%
Monday	45	22.5%	4,036	20.7%
Tuesday	32	16.0%	3,270	16.8%
Wednesday	29	14.5%	2,396	12.3%
Thursday	25	12.5%	2,548	13.1%
Friday	18	9.0%	1,741	8.9%
Saturday	30	15.0%	2,982	15.3%
Total	**200**	**100.0%**	**19,474**	**100.0%**
Time of the Day	**Annual Safety Belt Observations**			
	No. of Sites Observed	**Percent of Sites in Time of Day**	**Actual Total No. of Observations (Occupants)**	**Percent of Observations in Day of Week (Occupants)**
7 am – 8 am	12	6.0%	924	4.7%
8 am – 9 am	15	7.5%	1,324	6.8%
9 am – 10 am	14	7.0%	1,255	6.4%
10 am – 11 am	18	9.0%	1,818	9.3%
11 am – 12 pm	23	11.5%	2,435	12.5%
12 pm – 1 pm	26	13.0%	2,391	12.3%
1 pm – 2 pm	24	12.0%	2,041	10.5%
2 pm – 3 pm	19	9.5%	1,871	9.6%
3 pm – 4 pm	15	7.5%	1,587	8.1%
4 pm – 5 pm	13	6.5%	1,289	6.6%
5 pm – 6 pm	11	5.5%	1,548	7.9%
6 pm – 7 pm	10	5.0%	991	5.1%
Total	**200**	**100.0%**	**19,474**	**100.0%**

The safety belt use rate can be described by the overall use rate, as well as by vehicle type and various demographics. It should be noted the overall safety belt use rates presented in Table 7 and Tables 9 through 15 represent the raw (un-weighted) safety belt use data. These rates vary from the weighted annual use rate presented in Table 6. Table 9 summarizes the annual driver and front-seat passenger safety belt use rates by county and belt-use stratum. Because of the relatively low number of sites and/or observations in many counties, the safety belt use rates listed may not be fully representative of each county.

Table 9. Annual Safety Belt Use Rates by Stratum and County

STRATUM 1	Actual Total No. of Observations	Actual Belted No. of Observations	% Safety Belt Use
Ingham County	1,168	1,131	96.8%
Kalamazoo County	951	874	91.9%
Oakland County	1,491	1,414	94.8%
Washtenaw County	1,535	1,474	96.0%
Total	**5,145**	**4,893**	**95.1%**
STRATUM 2	**Actual Total No. of Observations**	**Actual Belted No. of Observations**	**% Safety Belt Use**
Allegan County	475	461	97.1%
Bay County	245	237	96.7%
Calhoun County	263	244	92.8%
Eaton County	540	504	93.3%
Grand Traverse County	330	312	94.5%
Jackson County	1,274	1,219	95.7%
Kent County	960	912	95.0%
Livingston County	245	242	98.8%
Midland County	176	166	94.3%
Monroe County	343	318	92.7%
Ottawa County	95	90	94.7%
Total	**4,946**	**4,705**	**95.1%**
STRATUM 3	**Actual Total No. of Observations.**	**Actual Belted No. of Observations**	**% Safety Belt Use**
Berrien County	278	253	91.0%
Branch County	78	74	94.9%
Cass County	290	260	89.7%
Clinton County	97	90	92.8%
Genesee County	547	501	91.6%
Hillsdale County	98	78	79.6%
Ionia County	285	267	93.7%
Lapeer County	179	165	92.2%
Lenawee County	376	357	94.9%
Marquette County	274	256	93.4%
Mecosta County	44	42	95.5%
Montcalm County	201	190	94.5%
Saginaw County	398	375	94.2%
St. Clair County	98	88	89.8%
St. Joseph County	145	132	91.0%
Tuscola County	167	152	91.0%
Van Buren County	887	826	93.1%
Wexford County	183	172	94.0%
Total	**4,625**	**4,278**	**92.5%**
STRATUM 4	**Actual Total No. of Observations**	**Actual Belted No. of Observations**	**% Safety Belt Use**
Macomb County	1,646	1,526	92.7%
Wayne County	3,112	2,921	93.9%
Total	**4,758**	**4,447**	**93.5%**
Grand Total (Unweighted)	**19,474**	**18,323**	**94.1%**

Strata 1 and 2 displayed the highest safety belt use rate (both at 95.1 percent), while Stratum 3 displayed the lowest safety belt use rate at 92.5 percent. Tables 10 through 14 summarize occupant safety belt use for drivers and front-seat passengers by vehicle type for each day of the week, time of the day, gender, age, and race for the Annual Observation Survey.

Table 10. All Vehicles Annual Belt Use Summary

Day of the Week	All Vehicle Safety Belt Use		
	Actual Total No. of Observations	**Actual Belted No. of Observations**	**% Safety Belt Use**
Sunday	2,501	2,409	96.3%
Monday	4,036	3,753	93.0%
Tuesday	3,270	3,055	93.4%
Wednesday	2,396	2,254	94.1%
Thursday	2,548	2,404	94.3%
Friday	1,741	1,645	94.5%
Saturday	2,982	2,803	94.0%
Total	**19,474**	**18,323**	**94.1%**
Time of the Day	**Actual Total No. of Observations**	**Actual Belted No. of Observations**	**% Safety Belt Use**
7 am – 8 am	924	878	95.0%
8 am – 9 am	1,324	1,238	93.5%
9 am – 10 am	1,255	1,184	94.3%
10 am – 11 am	1,818	1,713	94.2%
11 am – 12 pm	2,435	2,295	94.3%
12 pm – 1 pm	2,391	2,228	93.2%
1 pm – 2 pm	2,041	1,915	93.8%
2 pm – 3 pm	1,871	1,747	93.4%
3 pm – 4 pm	1,587	1,502	94.6%
4 pm – 5 pm	1,289	1,203	93.3%
5 pm – 6 pm	1,548	1,497	96.7%
6 pm – 7 pm	991	923	93.1%
Total	**19,474**	**18,323**	**94.1%**
Vehicle Type	**Actual Total No. of Observations**	**Actual Belted No. of Observations**	**% Safety Belt Use**
Passenger Cars	6,631	6,225	93.9%
Sport Utility Vehicles	7,237	6,921	95.6%
Vans/Minivans	2,017	1,941	96.2%
Pick-Up Trucks	3,589	3,236	90.2%
Total	**19,474**	**18,323**	**94.1%**
Gender	**Actual Total No. of Observations**	**Actual Belted No. of Observations**	**% Safety Belt Use**
Male	10,555	9,803	92.9%
Female	8,810	8,416	95.5%
Unknown	109	104	95.4%
Total	**19,474**	**18,323**	**94.1%**
Age	**Actual Total No. of Observations**	**Actual Belted No. of Observations**	**% Safety Belt Use**
0 - 15	290	286	98.6%
16 - 29	3,802	3,485	91.7%
30 - 59	11,775	11,093	94.2%
60+	3,544	3,397	95.9%
Unknown	63	62	98.4%
Total	**19,474**	**18,323**	**94.1%**
Race	**Actual Total No. of Observations**	**Actual Belted No. of Observations**	**% Safety Belt Use**
White	16,470	15,566	94.5%
Black	2,131	1,933	90.7%
Other	737	695	94.3%
Unknown	136	129	94.9%
Total	**19,474**	**18,323**	**94.1%**

Table 11. Passenger Cars Annual Belt Use Summary

Passenger Cars Safety Belt Use			
Day of the Week	**Actual Total No. of Observations**	**Actual Belted No. of Observations**	**% Safety Belt Use**
Sunday	857	826	96.4%
Monday	1,331	1,241	93.2%
Tuesday	1,213	1,130	93.2%
Wednesday	791	728	92.0%
Thursday	830	784	94.5%
Friday	588	556	94.6%
Saturday	1,021	960	94.0%
Total	**6,631**	**6,225**	**93.9%**
Time of the Day	**Actual Total No. of Observations**	**Actual Belted No. of Observations**	**% Safety Belt Use**
7 am – 8 am	364	343	94.2%
8 am – 9 am	434	410	94.5%
9 am – 10 am	368	350	95.1%
10 am – 11 am	544	518	95.2%
11 am – 12 pm	809	763	94.3%
12 pm – 1 pm	785	733	93.4%
1 pm – 2 pm	691	643	93.1%
2 pm – 3 pm	681	626	91.9%
3 pm – 4 pm	612	564	92.2%
4 pm – 5 pm	439	412	93.8%
5 pm – 6 pm	539	521	96.7%
6 pm – 7 pm	365	342	93.7%
Total	**6,631**	**6,225**	**93.9%**
Gender	**Actual Total No. of Observations**	**Actual Belted No. of Observations**	**% Safety Belt Use**
Male	3,568	3,328	93.3%
Female	3,019	2,855	94.6%
Unknown	44	42	95.5%
Total	**6,631**	**6,225**	**93.9%**
Age	**Actual Total No. of Observations**	**Actual Belted No. of Observations**	**% Safety Belt Use**
0 - 15	78	78	100.0%
16 - 29	1,889	1,735	91.8%
30 – 59	3,550	3,350	94.4%
60+	1,097	1,045	95.3%
Unknown	17	17	100.0%
Total	**6,631**	**6,225**	**93.9%**
Race	**Actual Total No. of Observations**	**Actual Belted No. of Observations**	**% Safety Belt Use**
White	5,206	4,934	94.8%
Black	1,060	947	89.3%
Other	304	286	94.1%
Unknown	61	58	95.1%
Total	**6,631**	**6,225**	**93.9%**

Table 12. Sport Utility Vehicles Annual Belt Use Summary

Sport Utility Vehicles Safety Belt Use			
Day of the Week	**Actual Total No. of Observations**	**Actual Belted No. of Observations**	**% Safety Belt Use**
Sunday	884	860	97.3%
Monday	1,357	1,284	94.6%
Tuesday	1,187	1,128	95.0%
Wednesday	932	892	95.7%
Thursday	975	939	96.3%
Friday	710	673	94.8%
Saturday	1,192	1,145	96.1%
Total	**7,237**	**6,921**	**95.6%**
Time of the Day	**Actual Total No. of Observations**	**Actual Belted No. of Observations**	**% Safety Belt Use**
7 am – 8 am	253	248	98.0%
8 am – 9 am	445	420	94.4%
9 am – 10 am	466	443	95.1%
10 am – 11 am	682	652	95.6%
11 am – 12 pm	931	897	96.3%
12 pm – 1 pm	882	832	94.3%
1 pm – 2 pm	759	722	95.1%
2 pm – 3 pm	710	673	94.8%
3 pm – 4 pm	625	607	97.1%
4 pm – 5 pm	485	460	94.8%
5 pm – 6 pm	602	588	97.7%
6 pm – 7 pm	397	379	95.5%
Total	**7,237**	**6,921**	**95.6%**
Gender	**Actual Total No. of Observations**	**Actual Belted No. of Observations**	**% Safety Belt Use**
Male	3,060	2,909	95.1%
Female	4,136	3,974	96.1%
Unknown	41	38	92.7%
Total	**7,237**	**6,921**	**95.6%**
Age	**Actual Total No. of Observations**	**Actual Belted No. of Observations**	**% Safety Belt Use**
0 - 15	120	116	96.7%
16 - 29	1,247	1,166	93.5%
30 – 59	4,336	4,148	95.7%
60+	1,505	1,462	97.1%
Unknown	29	29	100.0%
Total	**7,237**	**6,921**	**95.6%**
Race	**Actual Total No. of Observations**	**Actual Belted No. of Observations**	**% Safety Belt Use**
White	6,191	5,946	96.0%
Black	735	678	92.2%
Other	273	259	94.9%
Unknown	38	38	100.0%
Total	**7,237**	**6,921**	**95.6%**

Table 13. Van/Minivan Annual Belt Use Summary

Van/Minivans Safety Belt Use			
Day of the Week	**Actual Total No. of Observations**	**Actual Belted No. of Observations**	**% Safety Belt Use**
Sunday	312	305	97.8%
Monday	494	476	96.4%
Tuesday	333	318	95.5%
Wednesday	263	253	96.2%
Thursday	219	208	95.0%
Friday	171	166	97.1%
Saturday	225	215	95.6%
Total	**2,017**	**1,941**	**96.2%**
Time of the Day	**Actual Total No. of Observations**	**Actual Belted No. of Observations**	**% Safety Belt Use**
7 am – 8 am	126	125	99.2%
8 am – 9 am	154	150	97.4%
9 am – 10 am	167	157	94.0%
10 am – 11 am	192	188	97.9%
11 am – 12 pm	266	252	94.7%
12 pm – 1 pm	250	235	94.0%
1 pm – 2 pm	216	209	96.8%
2 pm – 3 pm	182	173	95.1%
3 pm – 4 pm	112	110	98.2%
4 pm – 5 pm	112	108	96.4%
5 pm – 6 pm	163	160	98.2%
6 pm – 7 pm	77	74	96.1%
Total	**2,017**	**1,941**	**96.2%**
Gender	**Actual Total No. of Observations**	**Actual Belted No. of Observations**	**% Safety Belt Use**
Male	1,094	1,037	94.8%
Female	914	895	97.9%
Unknown	9	9	100.0%
Total	**2,017**	**1,941**	**96.2%**
Age	**Actual Total No. of Observations**	**Actual Belted No. of Observations**	**% Safety Belt Use**
0 - 15	52	52	100.0%
16 - 29	223	211	94.6%
30 – 59	1,413	1,356	96.0%
60+	326	319	97.9%
Unknown	3	3	100.0%
Total	**2,017**	**1,941**	**96.2%**
Race	**Actual Total No. of Observations**	**Actual Belted No. of Observations**	**% Safety Belt Use**
White	1,725	1,670	96.8%
Black	187	174	93.0%
Other	86	81	94.2%
Unknown	19	16	84.2%
Total	**2,017**	**1,941**	**96.2%**

Table 14. Pick-Up Trucks Annual Belt Use Summary

Pick-up Truck Safety Belt Use			
Day of the Week	**Actual Total No. of Observations**	**Actual Belted No. of Observations**	**% Safety Belt Use**
Sunday	448	418	93.3%
Monday	854	752	88.1%
Tuesday	537	479	89.2%
Wednesday	410	381	92.9%
Thursday	524	473	90.3%
Friday	272	250	91.9%
Saturday	544	483	88.8%
Total	**3,589**	**3,236**	**90.2%**
Time of the Day	**Actual Total No. of Observations**	**Actual Belted No. of Observations**	**% Safety Belt Use**
7 am – 8 am	181	162	89.5%
8 am – 9 am	291	258	88.7%
9 am – 10 am	254	234	92.1%
10 am – 11 am	400	355	88.8%
11 am – 12 pm	429	383	89.3%
12 pm – 1 pm	474	428	90.3%
1 pm – 2 pm	375	341	90.9%
2 pm – 3 pm	298	275	92.3%
3 pm – 4 pm	238	221	92.9%
4 pm – 5 pm	253	223	88.1%
5 pm – 6 pm	244	228	93.4%
6 pm – 7 pm	152	128	84.2%
Total	**3,589**	**3,236**	**90.2%**
Gender	**Actual Total No. of Observations**	**Actual Belted No. of Observations**	**% Safety Belt Use**
Male	2,833	2,529	89.3%
Female	741	692	93.4%
Unknown	15	15	100.0%
Total	**3,589**	**3,236**	**90.2%**
Age	**Actual Total No. of Observations**	**Actual Belted No. of Observations**	**% Safety Belt Use**
0 - 15	40	40	100.0%
16 - 29	443	373	84.2%
30 – 59	2,476	2,239	90.4%
60+	616	571	92.7%
Unknown	14	13	92.9%
Total	**3,589**	**3,236**	**90.2%**
Race	**Actual Total No. of Observations**	**Actual Belted No. of Observations**	**% Safety Belt Use**
White	3,348	3,016	90.1%
Black	149	134	89.9%
Other	74	69	93.2%
Unknown	18	17	94.4%
Total	**3,589**	**3,236**	**90.2%**

Occupants of vans/minivans exhibited the highest safety belt use rate among vehicle types at 96.2 percent, followed closely by occupants of SUVs at 95.6 percent. Occupants of passenger cars exhibited a use rate of 93.9 percent, while occupants of pick-up trucks exhibited the lowest use rate at 90.2 percent; consistent with historical trends. Considering days of the week, Mondays demonstrated the lowest safety belt usage rate with 93.0 percent. Safety belt use rates were highest on Sundays with a rate of 96.3 percent. The time period of 6:00 PM to 7:00 PM exhibited a lower usage rate than all other times of the day (93.1 percent), while occupants were most likely to wear their safety belts between the hours of 5:00 PM to 6:00 PM (96.7 percent).

Female occupants had higher use rates than male occupants by 2.6 percent (95.5 percent use rate for females vs. 92.9 percent use rate for males). The safety belt usage rate was highest among occupants age 0 to 15 and above at 98.6 percent, and lowest for occupants between the ages of 16 to 29 (91.7 percent). The safety belt use rate for occupants age 30 to 59 was found to be 94.2 percent while the use rate was 95.9 percent among occupants ages 60 and above. Considering occupant races, the safety belt use rate was found to be lowest among black occupants (90.7 percent), while white occupants were found to have a safety belt use rate of 94.5 percent and occupants of 'other' and 'unknown' races were found to have belt use rates of 94.3 percent and 94.9%, respectively.

Table 15 summarizes occupant safety belt use rates by gender, age, and race. Vehicle occupants whose gender could not be identified were excluded from this demographic comparison. Black males ages 16 to 29 exhibited a low belt use rate of 85.5%. However it should be noted that the sample size for this group was relatively small. Similar to previous findings, white females of all ages generally exhibited the highest safety belt use rates compared with other demographics. Additionally, young male pick-up truck occupants exhibited the low safety belt use rates (89.3% for all male pickup truck occupants, and 84.2% for all pickup truck occupants ages 16 to 29), consistent with past findings.

Table 15. Annual Belt Use by Demographic Characteristics

Demographic Data			All Vehicles Safety Belt Use		
Gender	**Age**	**Race**	**Actual Total No. of Observations**	**Actual Belted No. of Observations**	**% Safety Belt Use**
Male	0 - 15	White	105	104	99.0%
		Black	30	30	100.0%
		Other	6	6	100.0%
		Unknown	2	2	100.0%
		Total	**143**	**142**	**99.3%**
	16 - 29	White	1,379	1,244	90.2%
		Black	234	200	85.5%
		Other	116	106	91.4%
		Unknown	8	7	87.5%
		Total	**1,737**	**1,557**	**89.6%**
	30 - 59	White	5,698	5,328	93.5%
		Black	731	647	88.5%
		Other	282	266	94.3%
		Unknown	61	58	95.1%
		Total	**6,772**	**6,299**	**93.0%**
	60+	White	1,746	1,654	94.7%
		Black	94	89	94.7%
		Other	31	31	100.0%
		Unknown	4	4	100.0%
		Total	**1,875**	**1,778**	**94.8%**
	Unknown	White	19	19	100.0%
		Black	1	1	100.0%
		Other	0	0	N/A
		Unknown	8	7	87.5%
		Total	**28**	**27**	**96.4%**
	TOTAL		**10,555**	**9,803**	**92.9%**

Table 15. Annual Belt Use by Demographic Characteristics (Continued)

Demographic Data			All Vehicles Safety Belt Use		
Gender	**Age**	**Race**	**Actual Total No. of Observations**	**Actual Belted No. of Observations**	**% Safety Belt Use**
Female	0 - 15	White	122	119	97.5%
		Black	14	14	100.0%
		Other	4	4	100.0%
		Unknown	2	2	100.0%
		Total	**142**	**139**	**97.9%**
	16 - 29	White	1,609	1,518	94.3%
		Black	321	286	89.1%
		Other	102	95	93.1%
		Unknown	13	12	92.3%
		Total	**2,045**	**1,911**	**93.4%**
	30 - 59	White	4,169	4,007	96.1%
		Black	597	559	93.6%
		Other	163	155	95.1%
		Unknown	25	24	96.0%
		Total	**4,954**	**4,745**	**95.8%**
	60+	White	1,521	1,475	97.0%
		Black	96	95	99.0%
		Other	27	26	96.3%
		Unknown	2	2	100.0%
		Total	**1,646**	**1,598**	**97.1%**
	Unknown	White	20	20	100.0%
		Black	1	1	100.0%
		Other	0	0	N/A
		Unknown	2	2	100.0%
		Total	**23**	**23**	**100.0%**
	TOTAL		**8,810**	**8,416**	**95.5%**

In comparison to 2018, the 2019 Annual survey revealed a 1.0% increase in safety belt usage from 93.4 percent in 2018 to 94.4 percent in 2019. In any case, continued public awareness and enforcement efforts are warranted to increase safety belt use. The careful evaluation of these media and enforcement efforts will allow for the identification of at-risk vehicle occupants and geographic areas prone to low belt use rates. As shown in this and previous studies, young males and pick-up truck drivers continue to exhibit lower safety belt use rates. Generally, belt use was also lower for those counties in Stratum 3. These areas should be emphasized in subsequent program efforts.

6.2 Mobile Device Use Results and Conclusions

As a part of the 2019 annual observational survey of safety belt use, mobile device use was also recorded for drivers only (passengers were not observed for mobile device use). A total of 1,069 drivers were observed using a mobile device in some way and the overall weighted mobile device use rate was found to be 7.5 percent. The weighted mobile device use rate (shown in Table 16) was calculated using the same procedure as the weighted safety belt rate described in the "Data Analysis" section of the report. This rate represents a 0.4 percent increase from the 7.1 percent mobile device use rate observed in Michigan in 2018. Nationally, the overall mobile device use rate by drivers was found to be 5.3 percent in 2017 [7] (the most recent national data available), which included hand-held talking, hands-free talking (earpiece observed), and typing, although hands-free devices with no earpiece observed were not included. Michigan's weighted mobile device use rate of 7.5 percent is slightly higher than the national average of 5.3 percent. Table 17 presents overall driver mobile device use, in addition to mobile device use by device type and type of use.

Table 16. Annual Weighted Mobile Device Use Rate for Drivers

Use by Category	Use Rate*	Standard Error
Overall Mobile Device Use	**7.5% ± 0.8%**	**0.4%**

* Weighted Mobile Device Usage ± 95% Confidence Band

Table 17. Annual Unweighted Mobile Device Use Rates by Use Type

Use by Category	Total # of Driver Observations	Total # of Drivers Observed Using Mobile Device	Percent of Mobile Device Use by Type (Drivers)
Talking – Hand-held Device	15,667	523	3.3%
Talking – Hands-free Device (Earpiece Observed)	15,667	39	0.2%
Talking – Hands-free Device (Earpiece Not Observed)	15,667	52	0.3%
Typing – Hand-held	15,667	455	2.9%
Overall Mobile Device Use	**15,667**	1,069	6.8%

Table 18 summarizes mobile device use for drivers in terms of day of the week, time of the day, vehicle type, gender, age and race. Females were found to be more likely to use a mobile device while driving than males (8.1 percent and 6.0 percent, respectively). The mobile device use rate was found to be highest between 6:00 pm and 7:00 pm at 10.3 percent, while the mobile device use rate was lowest between 7:00 am and 8:00 am (4.5 percent). Mobile device use among drivers less than 30 years of age was greatest at 10.7 percent, in comparison to 6.9 percent among those between ages 30 and 59 and 2.2 percent for

drivers age 60 and above. Additionally, black drivers tended to exhibit higher mobile device use rates while driving as compared to other demographics. Turning to days of the week, mobile device use was highest on Tuesdays (7.9%), and lowest on Sundays (3.2%). Finally, mobile device use was highest among drivers of vans/minivans (7.5%), and lowest among drivers of pickup trucks (5.6%).

Table 18. Annual Mobile Device Use Summary

Day of the Week	All Vehicles Mobile Device Use		
	Total No. of Driver Observations	**Total No. of Drivers Observed Using Mobile Device**	**Percent of Mobile Device Use (Drivers)**
Sunday	1,795	58	3.2%
Monday	3,370	241	7.2%
Tuesday	2,745	216	7.9%
Wednesday	2,000	141	7.1%
Thursday	2,097	156	7.4%
Friday	1,413	94	6.7%
Saturday	2,247	163	7.3%
Total	**15,667**	**1,069**	**6.8%**
Time of the Day	**All Vehicles Mobile Device Use**		
	Total No. of Driver Observations	**Total No. of Drivers Observed Using Mobile Device**	**Percent of Mobile Device Use (Drivers)**
7 am - 8 am	794	36	4.5%
8 am - 9 am	1,120	59	5.3%
9 am - 10 am	1,018	79	7.8%
10 am - 11 am	1,438	86	6.0%
11 am - 12 pm	1,936	102	5.3%
12 pm - 1 pm	1,925	136	7.1%
1 pm - 2 pm	1,585	85	5.4%
2 pm - 3 pm	1,512	131	8.7%
3 pm - 4 pm	1,290	128	9.9%
4 pm - 5 pm	1,054	62	5.9%
5 pm - 6 pm	1,198	83	6.9%
6 pm - 7 pm	797	82	10.3%
Total	**15,667**	**1,069**	**6.8%**

Table 18. Annual Mobile Device Use Summary (Continued)

Vehicle Type	All Vehicles Mobile Device Use		
	Total No. of Driver Observations	Total No. of Drivers Observed Using Mobile Device	Percent of Mobile Device Use (Drivers)
Passenger Cars	5,492	389	7.1%
Sport Utility Vehicles	5,772	406	7.0%
Vans/ Minivans	1,543	115	7.5%
Pick-Up Trucks	2,860	159	5.6%
Total	**15,667**	**1,069**	**6.8%**
Gender	**All Vehicles Mobile Device Use**		
	Total No. of Driver Observations	**Total No. of Drivers Observed Using Mobile Device**	**Percent of Mobile Device Use (Drivers)**
Male	9,152	547	6.0%
Female	6,434	519	8.1%
Unknown	81	3	3.7%
Total	**15,667**	**1,069**	**6.8%**
Age	**All Vehicles Mobile Device Use**		
	Total No. of Driver Observations	**Total No. of Drivers Observed Using Mobile Device**	**Percent of Mobile Device Use (Drivers)**
16-29	2,944	314	10.7%
30-59	10,048	696	6.9%
60+	2,632	57	2.2%
Unknown	43	2	4.7%
Total	**15,667**	**1,069**	**6.8%**
Race	**All Vehicles Mobile Device Use**		
	Total No. of Driver Observations	**Total No. of Drivers Observed Using Mobile Device**	**Percent of Mobile Device Use (Drivers)**
White	13,252	793	6.0%
Black	1,729	230	13.3%
Other	571	38	6.7%
Unknown	115	8	7.0%
Total	**15,667**	**1,069**	**6.8%**

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4. Seat Belt Use in 2018 – Overall Results. Traffic Safety Facts Research Note. Report No. DOT HS 812 662. Washington, DC: National Highway Traffic Safety Administration, January 2019.
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APPENDIX I
Michigan Safety Belt Survey Cover Sheet and Data Collection Form

DIRECT OBSERVATION SURVEY COVER SHEET

Date: _____ - _____ - 2019 **Observer's Name:_____**

Site Identification:

Site Location: _____

Site Number:_____

City_____County_____Stratum_____

Alternate Site Information:

Is this an alternate site? No Yes
(Circle one)

If yes, please provide a reason for using an alternate site from the reserve list:

_____

Site Description:

Observation direction: Northbound Southbound Eastbound Westbound

Number of lanes observed: _____

Total number of lanes in this direction: _____

Weather Conditions: Clear Light Fog Light Rain

Site Start and End Time:

Start time: _____am/pm **End time: _____am/pm**

Sample Size

60 Minute Volume Count (for lanes being observed): _____Vehicles

Number of Observations Recorded in 60 min: _____Vehicles

OBSERVATION DATA COLLECTION SHEET

SITE #________ OBSERVATION No.'s____ - ____ PAGE #_______

VEHICLE TYPE:			
□Passenger Car	□SUV	□Van/Minivan	□Pickup Truck

OBSERVABLE?	VEHICLE USE:	DRIVER CELL PHONE USE	
□Vehicle NOT Observable	□Non-Commercial □Commercial	□Handheld (Talking) □Handheld (Typing)	□Hands-free (E.P.) □Hands-free (NO E.P.)

DRIVER

BELT USE:	AGE:	GENDER:	RACE:
□Belted	□16-29	□Male	□White
□Not Belted	□30-59	□Female	□Black
□Unknown	□60+	□Unknown	□Other
	□Unknown		□Unknown

□No Passenger PASSENGER

BELT USE:	AGE:	GENDER:	RACE:
□Belted	□0 to 15	□Male	□White
□Not Belted	□16-29	□Female	□Black
□Unknown	□30-59	□Unknown	□Other
	□60+		□Unknown
	□Unknown		

VEHICLE TYPE:			
□Passenger Car	□SUV	□Van/Minivan	□Pickup Truck

OBSERVABLE?	VEHICLE USE:	DRIVER CELL PHONE USE	
□Vehicle NOT Observable	□Non-Commercial □Commercial	□Handheld (Talking) □Handheld (Typing)	□Hands-free (E.P.) □Hands-free (NO E.P.)

DRIVER

BELT USE:	AGE:	GENDER:	RACE:
□Belted	□16-29	□Male	□White
□Not Belted	□30-59	□Female	□Black
□Unknown	□60+	□Unknown	□Other
	□Unknown		□Unknown

□No Passenger PASSENGER

BELT USE:	AGE:	GENDER:	RACE:
□Belted	□0 to 15	□Male	□White
□Not Belted	□16-29	□Female	□Black
□Unknown	□30-59	□Unknown	□Other
	□60+		□Unknown
	□Unknown		

VEHICLE TYPE:			
□Passenger Car	□SUV	□Van/Minivan	□Pickup Truck

OBSERVABLE?	VEHICLE USE:	DRIVER CELL PHONE USE	
□Vehicle NOT Observable	□Non-Commercial □Commercial	□Handheld (Talking) □Handheld (Typing)	□Hands-free (E.P.) □Hands-free (NO E.P.)

DRIVER

BELT USE:	AGE:	GENDER:	RACE:
□Belted	□16-29	□Male	□White
□Not Belted	□30-59	□Female	□Black
□Unknown	□60+	□Unknown	□Other
	□Unknown		□Unknown

□No Passenger PASSENGER

BELT USE:	AGE:	GENDER:	RACE:
□Belted	□0 to 15	□Male	□White
□Not Belted	□16-29	□Female	□Black
□Unknown	□30-59	□Unknown	□Other
	□60+		□Unknown
	□Unknown		

Note: E.P. = Ear Piece

APPENDIX II
Resumes of Timothy J. Gates and Peter T. Savolainen

Dr. Timothy J. Gates

Summary

Dr. Timothy J. Gates is the current Principal Investigator of the Direct Observation Survey of Safety Belt Use. Dr. Gates is an Associate Professor in the Michigan State University (MSU) Department of Civil and Environmental Engineering. He has more than 10 years of experience with direct observation surveys of safety restraint use. This includes a diverse range of experiences in sample design and selection, field data collection methods, observer training, statistical systems development, and optimization techniques. He also has expertise in the areas of survey research methodology, data processing, and statistical quality control.

Education

Ph.D., Civil Engineering, University of Wisconsin, 2007
M.S., Civil Engineering, Michigan State University, 2000
B.S., Civil Engineering, Michigan State University, 1999

Professional Associations

American Society of Civil Engineers
Institute of Transportation Engineers
Transportation Research Board

Computer Skills

Operation Systems: Windows, iOs
Software: SPSS, Microsoft PowerPoint, Excel and Word

Relevant Project Experience (2007 to Present)

Direct Observation Surveys of Seat Belt Use –PI or co-PI on OHSP-sponsored Michigan safety belt use survey from FY 2012 to present. Participated in proposal development, planning, survey implementation, data collection, quality control, data analysis, and report preparation. Led the resampling of Michigan's 200 safety belt observation sites for use beginning with the 2018 survey.

Direct Observation Surveys of Commercial Motor Vehicle Seat Belt Use – Co-PI on OHSP-sponsored Michigan seat belt use survey for commercial motor vehicle occupants during FY 2012 and 2015.

Direct Observation Surveys of Child Restraint Device Use and Misuse (including Booster Seat Use) – PI or co-PI on OHSP-sponsored child restraint device use/misuse survey, including booster seats in FY 2009, 2011, 2013, 2015, and 2018.

Direct Observation Surveys of Motorcycle Helmet Use – co-PI on OHSP-sponsored motorcycle helmet use survey in FY 2013 and 2017.

Dr. Peter T. Savolainen

Summary

Dr. Peter T. Savolainen is an MSU Foundation Professor in the Michigan State University Department of Civil and Environmental Engineering. Dr. Savolainen serves as the lead statistical advisor for this project. Prior to joining Michigan State University in 2018, he was an Associate Professor of Civil Engineering at Iowa State University (2014-2018) and Wayne State University (2006-2014). He has more than 11 years of experience with direct observation surveys of safety restraint use. This includes a diverse range of experiences in sample design and selection, data weighting, imputation, variance estimation, statistical systems development, and optimization techniques. He also has expertise in the areas of survey research methodology, data processing, and statistical quality control. Dr. Savolainen also teaches graduate level courses on civil engineering research methods and applications, as well as statistics and econometric methods of data analysis. He is a proficient user of various statistical analysis software packages, including LIMDEP, SAS, SPSS, and SUDAAN.

Education

Ph.D., Civil Engineering, Purdue University, 2006
M.S., Civil Engineering, Purdue University, 2004
B.S., Civil Engineering, Michigan Technological University, 2002

Professional Associations

American Society of Civil Engineers
American Statistical Association
Institute of Transportation Engineers

Computer Skills

Operation Systems: Windows, iOs
Software: LIMDEP, SAS, SPSS, SUDAAN, Microsoft PowerPoint, Excel and Word

Relevant Project Experience (2006 to Present)

Direct Observation Surveys of Seat Belt Use –PI or co-PI on OHSP-sponsored Michigan safety belt use survey from FY 2008 to 2010 and FY 2012 to present. Participated in proposal development, planning, survey implementation, data collection, quality control, data analysis, and report preparation. Led development of the federally-approved safety belt observational survey methodology for the state of Michigan in 2012.

Direct Observation Surveys of Commercial Motor Vehicle Seat Belt Use – Co-PI on OHSP-sponsored Michigan seat belt use survey for commercial motor vehicle occupants during FY 2012.

Direct Observation Surveys of Child Restraint Device Use and Misuse (including Booster Seat Use) – PI or co-PI on OHSP-sponsored child restraint device use/misuse survey, including booster seats in FY 2009, 2011, 2013, 2015, and 2018.

Direct Observation Surveys of Motorcycle Helmet Use – co-PI on OHSP-sponsored motorcycle helmet use survey in FY 2013.

APPENDIX III

List of Annual Observation Locations by County, Stratum, and Road Classification Including Belt Use Observation Data

Belt Use Stratum	County	Site Location	Site Type	Road Type	Actual Observations		Sample Weight
					Belted	Total	
1	INGHAM	I-96 and Okemos Road	Original	Primary	186	188	42166.7
1	INGHAM	I-96 and N. Williamston Road (Exit 117A)	Original	Primary	29	30	15415.9
1	INGHAM	I-96 and Stockbridge Road (M-43)	Original	Primary	91	97	23539.4
1	KALAMAZOO	I-94 and Oakland Drive	Original	Primary	136	143	74231.5
1	KALAMAZOO	I-94 and S. 9th Street	Original	Primary	140	149	87730.3
1	OAKLAND	I-75 and Baldwin Road	Original	Primary	97	97	61107.2
1	OAKLAND	I-75 and Ortonville Road (M-15)	Original	Primary	91	93	89762.6
1	OAKLAND	I-75 and Grange Hall Road	Original	Primary	64	68	59301.8
1	OAKLAND	I-96 and Milford Road	Original	Primary	88	92	51256.4
1	OAKLAND	I-75 (Chrysler Fwy) and Twelve Mile Road	Original	Primary	65	75	41345.6
1	OAKLAND	I-696 (Walter P Reuther Fwy) and Greenfield Road	Original	Primary	84	88	106073.4
1	OAKLAND	I-96 and Wixom Road North	Original	Primary	76	77	38680.3
1	WASHTENAW	I-94 and Rawsonville Road	Original	Primary	106	115	62791.4
1	WASHTENAW	I-94 and S. Huron Street	Original	Primary	128	134	108773.5
1	WASHTENAW	I-94 and Chelsea Manchester Road (M-52)	Original	Primary	114	118	21875.0
1	INGHAM	E. Saginaw St (M-43) and Marshall Street	Original	Secondary	88	90	111471.0
1	INGHAM	Old U.S. 27 (N. Larch St) and Lake Lansing Road / Douglas Ave	Original	Secondary	75	82	78793.6
1	INGHAM	M-52 (W. Main St.) and S. M-106 (Clinton St.)	Original	Secondary	193	200	17451.0
1	INGHAM	US-127 and Holt Road	Original	Secondary	107	108	16307.9
1	INGHAM	US-127 and Cedar Street (M-36)	Original	Secondary	97	97	16510.1
1	INGHAM	US-127 and W. Barnes Road	Original	Secondary	79	85	15622.5
1	INGHAM	Perry Rd (M-52) and E. Grand River Avenue (M-43)	Original	Secondary	93	94	28240.4
1	INGHAM	Stockbridge Rd (M-43) and E. Grand River Avenue (M-43)	Original	Secondary	93	97	30721.3
1	KALAMAZOO	Michigan Ave (M-36) and 35th Street	Original	Secondary	157	179	43483.1
1	KALAMAZOO	Bus US-131 and Douglas Avenue	Original	Secondary	44	48	15953.2
1	KALAMAZOO	US-131 and W. U Avenue	Original	Secondary	94	104	55933.3
1	KALAMAZOO	E. D Ave and N. 32nd Street (M-89)	Original	Secondary	166	179	34707.3
1	KALAMAZOO	M-89 and N. 34th Street	Original	Secondary	137	149	30099.7
1	OAKLAND	S Lapeer Rd (M-24) and Drahner Road	Original	Secondary	73	77	265275.3
1	OAKLAND	Highland Rd (M-59) and N. Milford Road	Original	Secondary	96	99	90745.7
1	OAKLAND	E 8 Mile Rd (M-102) and John R Road	Original	Secondary	95	107	233615.8
1	OAKLAND	Telegraph Rd (US-24) and Quarton Road	Original	Secondary	106	109	282455.9
1	OAKLAND	Highland Rd (M-59) and Airport Road	Original	Secondary	96	97	167961.7
1	OAKLAND	Bus I- 75 (N. Perry St.) and Glenwood Ave	Original	Secondary	89	109	175243.6
1	OAKLAND	W Square Lake Rd (Bus US-24) and Franklin Road	Original	Secondary	99	100	327336.2
1	OAKLAND	Woodward Ave (M-1) and E. Long Lake Road	Original	Secondary	119	120	366060.6
1	WASHTENAW	M-52 (Ann Arbor St.) and E. Main Street	Original	Secondary	120	136	31044.9
1	WASHTENAW	Ecorse Rd (M-17) and S. Ford Blvd. / Dorset Ave	Original	Secondary	117	125	77564.4
1	WASHTENAW	US-23 and W. Michigan Ave (US-12)	Original	Secondary	119	121	23581.7
1	WASHTENAW	US-23 and E. Willis Road	Original	Secondary	86	88	16127.6
1	WASHTENAW	Main St. (M-52) and Middle Street	Original	Secondary	146	148	31619.5
1	WASHTENAW	M-14 and Whitmore Lake Road	Original	Secondary	169	172	24422.3
1	WASHTENAW	M-14 (Exit 2) and Maple Road	Original	Secondary	181	185	46237.0
1	WASHTENAW	M-14 and Gotfredson Road	Original	Secondary	86	86	36619.6
1	WASHTENAW	M-153 (Exit 10 from M-14) and Plymouth Road	Original	Secondary	91	94	100060.6
1	OAKLAND	W Rutland St and 13 Mile Road	Original	Local	3	4	1822658.8
1	OAKLAND	Glengary Rd and S. Commerce Road	Original	Local	72	77	3749846.6
1	OAKLAND	Standard St and Crescent Lake Road	Original	Local	1	2	2559238.7
1	WASHTENAW	Riker Road and Island Lake Road	Original	Local	1	1	2020358.3
1	WASHTENAW	Coyle Road and 6 Mile Road/Whitmore Lake Road	Original	Local	10	12	2054620.2

Belt Use Stratum	County	Site Location	Site Type	Road Type	Actual Observations		Sample Weight
					Belted	Total	
2	ALLEGAN	I-196/US-31 and 124th Ave (M-89)	Original	Primary	43	43	49781.0
2	ALLEGAN	I-196 and Lincoln Road (M-40)	Original	Primary	78	79	77964.3
2	BAY	I-75 (US-23) and E. Beaver Road	Original	Primary	58	60	37163.8
2	CALHOUN	I-69 and Michigan Avenue (M-96)	Original	Primary	103	110	48349.8
2	CALHOUN	I-94 and C Drive N	Original	Primary	72	80	36420.6
2	CALHOUN	I-94 and 26 Mile Rd. (M-199)	Original	Primary	22	24	31297.3
2	CALHOUN	I-69 and N. Drive N / Turkeyville Rd.	Original	Primary	35	36	30747.4
2	EATON	I-69 and Ainger Road	Original	Primary	20	21	29652.2
2	EATON	I-69 and S. Cochran Ave (Bus I-69)	Original	Primary	64	72	32521.5
2	EATON	I-69 and W. Saginaw Hwy (M-43)	Original	Primary	92	97	43884.3
2	JACKSON	I-94 and N. Dearing Road	Original	Primary	8	8	33351.5
2	JACKSON	I-94 and N. Elm Ave	Original	Primary	134	138	37441.8
2	JACKSON	I-94 and Mt. Hope Road	Original	Primary	100	104	33407.6
2	LIVINGSTON	I-96 and Grand River Ave	Original	Primary	125	126	126595.1
2	OTTAWA	I-196 (Gerald Ford Fwy) and 32nd Ave	Original	Primary	69	73	30805.8
2	ALLEGAN	US-131 and 142nd Ave	Original	Secondary	80	92	42798.1
2	ALLEGAN	US-131 and W. Superior Street	Original	Secondary	113	113	55995.9
2	ALLEGAN	Lincoln Rd (M-40) and I-196 (Gerald R. Ford Fwy)	Original	Secondary	103	104	121859.0
2	ALLEGAN	Lincoln Rd (M-40) and Interchange Drive	Original	Secondary	44	44	260814.4
2	BAY	M-25 (W. Jenny St) and S. Euclid Ave (M-13)	Original	Secondary	130	133	70310.1
2	BAY	M-47 and W. Salzburg Road	Original	Secondary	49	52	42537.4
2	EATON	Cochran Ave (Bus I- 69) and W. Shepherd Street / Upland Ave	Original	Secondary	140	154	90853.4
2	EATON	W. Saginaw Hwy (M-43) and I-69 North Ramp	Original	Secondary	88	89	307138.6
2	EATON	M-43 (W. Saginaw Hwy) and Jenne Street	Original	Secondary	100	107	143893.4
2	GRAND TRAVERSE	US-31 and S. South Long Lake (M-137)	Original	Secondary	167	175	195828.9
2	GRAND TRAVERSE	E Traverse Hwy (M-72) and S. Bugai Road/Gray Road	Original	Secondary	145	155	111815.5
2	JACKSON	Wamplers Lake Rd. (M-124) and S. Main Street (M-50)	Original	Secondary	97	108	67056.8
2	JACKSON	US-127 and I-94 West Ramp	Original	Secondary	206	210	149798.8
2	JACKSON	Clinton Rd (M-50) and Rives Junction Road	Original	Secondary	101	113	58110.6
2	JACKSON	Eaton Rapids Rd (M-99) and E. Main Street	Original	Secondary	63	68	37411.7
2	JACKSON	Brooklyn Rd (M-50) and US-127 NB Ramps	Original	Secondary	177	177	70942.5
2	JACKSON	US-127 and Page Ave	Original	Secondary	220	231	55076.9
2	KENT	US-131 and 17 Mile Road NE (M-46)	Original	Secondary	164	175	74303.7
2	KENT	Belding Rd NE (M-44) and Wolverine Blvd NE (M-44)	Original	Secondary	102	105	144133.1
2	KENT	Alpine Ave NW (M-37) and Lamoreaux Dr. NW	Original	Secondary	131	135	317178.9
2	KENT	US-131 and Ann St. NW	Original	Secondary	88	92	185247.7
2	KENT	Paul B. Henry Fwy (M-6) and Byron Center Ave SW	Original	Secondary	126	132	84811.0
2	KENT	M-6 (Paul B. Henry Fwy) and Wilson Ave SW	Original	Secondary	82	83	50522.9
2	KENT	US-131 and 84th Street SW	Original	Secondary	121	136	63359.9
2	LIVINGSTON	US-23 and Silver Lake Road	Original	Secondary	102	102	53812.1
2	MIDLAND	US-10 and N. Stark Road	Original	Secondary	46	50	48119.6
2	MIDLAND	US-10 and Waldo Ave	Original	Secondary	120	126	78851.7
2	MONROE	N. Monroe St (M-125) and Stewart Road	Original	Secondary	138	150	159340.0
2	MONROE	S. Telegraph Rd (US-24) and W. Albion Road	Original	Secondary	166	174	90078.9
2	OTTAWA	Chicago Dr (M-121) and 48th Ave	Original	Secondary	21	22	38051.6
2	CALHOUN	2 Mile Rd / Collier Ave and Meachem Road / U Dr N	Original	Local	12	13	2854114.5
2	JACKSON	W High St and S W. Ave	Original	Local	113	117	3945777.6
2	KENT	Clay Ave SW and 36th Street	Original	Local	98	102	8291868.6
2	LIVINGSTON	Dutcher Rd and Lange Road	Original	Local	15	17	2834521.1
2	MONROE	Oakdale Ave and Douglas Road	Original	Local	14	19	3124529.8

Belt Use Stratum	County	Site Location	Site Type	Road Type	Actual Observations		Sample Weight
					Belted	Total	
3	BERRIEN	I- 94 and Friday Road	Original	Primary	50	54	31929.9
3	BERRIEN	I-94 and M-140 (S. Main St.)	Original	Primary	75	82	33483.4
3	BRANCH	I-69 and Jonesville Road	Original	Primary	74	78	40081.9
3	GENESEE	I-75/US-23 and Corunna Road (M-21)	Original	Primary	107	116	79102.8
3	GENESEE	I-75/US-23 and Miller Road	Original	Primary	110	118	93980.7
3	LAPEER	I-69 and Van Dyke Road (M-53)	Original	Primary	66	66	181003.1
3	SAGINAW	I-75 (US-23) and Dixie Highway	Original	Primary	70	71	31784.0
3	SAGINAW	I-75 (US-23) and Bay City Road (M-13)	Original	Primary	89	94	50493.4
3	SAGINAW	I-675 and Davenport Ave (M-58)	Original	Primary	126	134	116340.2
3	ST. CLAIR	I-94 and Fred W. Moore Hwy	Original	Primary	47	48	44493.9
3	ST. CLAIR	I-94 and Range Road	Original	Primary	41	50	35797.3
3	VAN BUREN	I-94 and County Road 687	Original	Primary	60	65	31813.9
3	VAN BUREN	I-196/US-31 and M-140 (Bus I-196)	Original	Primary	67	72	31270.8
3	VAN BUREN	I-196 and Phoenix Street	Original	Primary	83	88	33806.5
3	VAN BUREN	I-94 and N. County Road 365	Original	Primary	27	30	31240.0
3	BERRIEN	N. 5th Street (M-51) and Sycamore Street	Original	Secondary	128	142	108446.4
3	CASS	M 51 (N. Front St.) and Prairie Ronde Street	Original	Secondary	69	81	60049.2
3	CASS	M-62 and Main Street (US-12)	Original	Secondary	130	143	122266.1
3	CLINTON	US-127 and Old US 27 / State Rd.	Original	Secondary	18	20	71205.1
3	CLINTON	W. M 21 and S. Main Street	Original	Secondary	72	77	88495.3
3	GENESEE	N. State Road (M-15) and E. Dodge Road	Original	Secondary	93	108	136660.5
3	GENESEE	Sheridan Road (M-13) and Vienna Road (M-57)	Original	Secondary	107	115	115965.8
3	GENESEE	Sheridan Road (M-13) and Corunna Road (M-21)	Original	Secondary	84	90	103142.4
3	HILLSDALE	US-127 (Meridian Rd.) and Main Street / Hudson Rd.	Original	Secondary	78	98	93539.5
3	IONIA	Bluewater Hwy (M-21) and N. State Street (M-66)	Original	Secondary	131	139	175804.2
3	IONIA	S State Rd (M-66) and W. Tuttle Road	Original	Secondary	136	146	179693.7
3	LAPEER	E Burnside Rd (M-90) and N. Van Dyke Road (M-53)	Original	Secondary	63	69	100434.3
3	LENAWEE	US-12 and M-50	Original	Secondary	147	155	146169.3
3	LENAWEE	US-223 (W. Adrian St.) and Monroe Street	Original	Secondary	210	221	204526.0
3	MARQUETTE	US-41 and Cherry Creek Road (M-28)	Original	Secondary	63	66	428043.8
3	MARQUETTE	M-553 and County Road 480	Original	Secondary	70	75	277302.3
3	MARQUETTE	S. Front St (M-28/US-41) and Genesee/S. Lakeshore Blvd	Original	Secondary	123	133	616723.7
3	MECOSTA	US-131 and Jefferson Road	Original	Secondary	42	44	59385.0
3	MONTCALM	US-131/M-46 and Cannonsville Road	Original	Secondary	26	30	59345.9
3	MONTCALM	Howard City Edmore Rd (M-46) and M-66 (6 Lakes Rd.)	Original	Secondary	151	156	169455.2
3	SAGINAW	Gratiot Road (M-46) and Center Road	Original	Secondary	90	99	269534.5
3	ST. JOSEPH	M-60 and US-131 South	Original	Secondary	109	116	127146.0
3	TUSCOLA	Bay Street (M-25) and Center Street (M-24)	Original	Secondary	73	78	122958.7
3	TUSCOLA	Sanilac Road (M-46) and Saginaw Road (M-15)	Original	Secondary	79	89	118512.0
3	VAN BUREN	M-51 (Deleware St.) and Phelps Street	Original	Secondary	181	200	110740.7
3	VAN BUREN	M-51 (43rd St.) and W. Red Arrow Highway	Original	Secondary	152	164	102399.7
3	VAN BUREN	M-40 (Kalamazoo St.) and W. Michigan Avenue	Original	Secondary	123	129	204947.3
3	VAN BUREN	M-43 and M-40	Original	Secondary	133	139	224137.9
3	WEXFORD	US-131 and W. 16 Rd (Bus US-131/M-42)	Original	Secondary	36	39	59368.1
3	WEXFORD	M-115 and W. 13th Street	Original	Secondary	136	144	210894.1
3	CASS	Calvin Center Road and US-12	Original	Local	61	66	4460052.8
3	LAPEER	Brown City Rd and E. Burnside Road (M-90)	Original	Local	36	44	5324436.8
3	MONTCALM	Keeney Rd and Waterwheel Road	Original	Local	13	15	3193351.4
3	MONTCALM	S. County Line Rd. and Blackner/O'Brien Road	Original	Local	0	0	0.0
3	ST. JOSEPH	Lake Rd and Eagley Road	Original	Local	23	29	4467286.2

Belt Use Stratum	County	Site Location	Site Type	Road Type	Actual Observations		Sample Weight
					Belted	Total	
4	MACOMB	I-94 (Edsel Ford Fwy) and Washington Street (M-19)	Original	Primary	69	71	61917.2
4	MACOMB	E. Eleven Mile Rd (I-696 Service Drive) and Van Dyke (M-53)	Original	Primary	92	104	116240.2
4	MACOMB	I-94 and 16 Mile Road	Original	Primary	100	106	77183.5
4	WAYNE	I-275 and Sibley Road	Original	Primary	90	94	44143.1
4	WAYNE	I-275 and Eureka Road	Original	Primary	86	94	66396.3
4	WAYNE	I-75 and Eureka Road	Original	Primary	85	88	26944.7
4	WAYNE	I- 96 (Jeffries Fwy Service Dr/Schoolcraft) and Beech Daly	Original	Primary	100	114	81421.2
4	WAYNE	Chrysler Fwy Service Drive (I-75) and Warren Ave	Original	Primary	93	102	60157.3
4	WAYNE	I-94 (Harper Ave/Ford Fwy Service Drive) and Allard Ave	Original	Primary	95	101	38208.3
4	WAYNE	I-75 and Southfield Road (M-39)	Original	Primary	90	91	65477.1
4	WAYNE	I-94 and Enterprise Drive	Original	Primary	66	70	37519.1
4	WAYNE	I- 75 and Northline Rd	Original	Primary	102	106	42720.7
4	WAYNE	I-275 and Ecorse Road	Original	Primary	85	88	182838.6
4	WAYNE	I-275 and Ann Arbor Road	Original	Primary	96	104	73654.1
4	WAYNE	I- 75 and Sibley Rd	Original	Primary	118	120	45429.7
4	MACOMB	23 Mile Rd (M-29) and Jefferson Ave	Original	Secondary	52	58	63008.7
4	MACOMB	Gratiot Ave (M-19) and 31 Mile Road	Original	Secondary	65	76	45217.0
4	MACOMB	Van Dyke and 28 Mile Road	Original	Secondary	68	77	119364.6
4	MACOMB	M-53 (Van Dyke Fwy) and Van Dyke Rd	Original	Secondary	79	87	71877.4
4	MACOMB	23 Mile Rd (M-29) and Donner Road/I-94 East Ramp	Original	Secondary	68	74	230335.7
4	MACOMB	M-53 (Van Dyke Fwy) and 23 Mile Road	Original	Secondary	95	104	96579.3
4	MACOMB	Dobry Dr. (M-53 Service Drive) and Mound Road	Original	Secondary	67	70	143856.3
4	MACOMB	M-53 (Van Dyke Fwy) and M-53 (Hall Rd.)	Original	Secondary	72	79	31141.4
4	MACOMB	Hall Rd (M-59) and Schoenherr Road	Original	Secondary	77	79	235197.8
4	MACOMB	Hall Rd (M-59) and Westbrook Drive	Original	Secondary	84	84	268681.1
4	MACOMB	Northbound Gratiot Ave (M-3) and Market Street	Original	Secondary	103	112	62598.5
4	MACOMB	Gratiot Ave (M-3) and Utica Road	Original	Secondary	81	92	88248.9
4	MACOMB	Van Dyke (M-53) and Chicago Road	Original	Secondary	90	103	182482.4
4	MACOMB	Van Dyke (M-53) and 15 Mile Road	Original	Secondary	108	112	147610.0
4	WAYNE	Telegraph Rd (US-24) and Goddard Road	Original	Secondary	93	104	176301.3
4	WAYNE	Vernier Rd (M-102) and E. 8 Mile Road	Original	Secondary	98	106	31860.3
4	WAYNE	Groesbeck Hwy (M-97) and 8 Mile Rd (M-102)	Original	Secondary	118	130	33174.4
4	WAYNE	M-14 and Sheldon Rd	Original	Secondary	122	128	108407.0
4	WAYNE	Grand River Ave and Lodge Fwy/M-10 Service Drive	Original	Secondary	86	90	30284.9
4	WAYNE	John C Lodge Fwy (M-10 Service Drive) and Grand River Ave	Original	Secondary	107	114	85276.0
4	WAYNE	Michigan Ave (US-12) and Rosa Parks Blvd	Original	Secondary	87	97	66377.3
4	WAYNE	Michigan Ave (US-12) and 14th St/Vernor Hwy/Fisher Svc Dr	Original	Secondary	71	72	22011.4
4	WAYNE	Michigan Ave (US-12) and Haggerty Road	Original	Secondary	114	118	110143.5
4	WAYNE	Ford Rd (M-153) and N. Canton Center Road	Original	Secondary	95	98	66321.0
4	WAYNE	Southfield Rd (M-39) and Allen Rd	Original	Secondary	144	157	108383.4
4	WAYNE	Fort St (M-85) and Northline Rd	Original	Secondary	127	127	157286.0
4	WAYNE	Telegraph Rd (US-24) and King Rd	Original	Secondary	114	118	134250.7
4	WAYNE	Grand River Ave (M-5) and Outer Drive W	Original	Secondary	105	124	82739.0
4	WAYNE	Telegraph Rd and Grand River Ave (M-5)	Original	Secondary	116	118	161177.8
4	WAYNE	Telegraph Rd and Six Mile/McNichols	Original	Secondary	108	120	225271.6
4	MACOMB	Commons Drive and 23 Mile Road	Original	Local	7	7	1373693.6
4	MACOMB	Walnut Creek Dr and 22 Mile Road	Original	Local	33	34	2063038.8
4	MACOMB	25 Mile Rd and Hayes Road	Original	Local	116	117	8758651.9
4	WAYNE	W Jefferson Ave and Van Horn Road	Original	Local	76	81	4593046.0
4	WAYNE	Pine St and Middlebelt Rd	Original	Local	34	38	1789746.4