2018 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 2018

MICHIGAN OHSP Office of Highway Safety Planning

MICHIGAN STATE UNIVERSITY

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16. Abstract:
This report documents the results of the 2018 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 2018. 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 2018 is 93.4 percent. This represents a slight decrease from the 94.1 percent use rate observed during the 2017 Annual Direct Observation Survey, though the change is not statistically significant. 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 7.1 percent, which represents an increase from the 6.0 percent device use rate observed during the 2017 Annual Direct Observation Survey.

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TABLE OF CONTENTS **PAGE**

LIST OF FIGURES **PAGE**

LIST OF TABLES **PAGE**

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 the first half of 2017 alone, a statistical projection estimated 17,530 people were killed in motor vehicle crashes in the United States; only a marginal decrease of 0.6 percent compared with 2016 [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 2016 alone, safety belts saved approximately 14,668 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 2017 nationwide safety belt survey, 89.7 percent of drivers and right-front passengers use safety belts, which is a marginal decrease from the 90.1 percent observed in 2016 [4]. The Midwest region as a whole showed an 88.6 percent safety belt use rate in 2017, an increase from the 85.5 percent safety belt use rate observed in 2016 [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 2017 use rate was 93.4 percent, indicating the use rate in Michigan one of 23 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 (2017) indicate that states with primary safety belt laws exhibited an average use rate of 90.9 percent, which is 5.2 percent higher than the 85.7 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 2018 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.

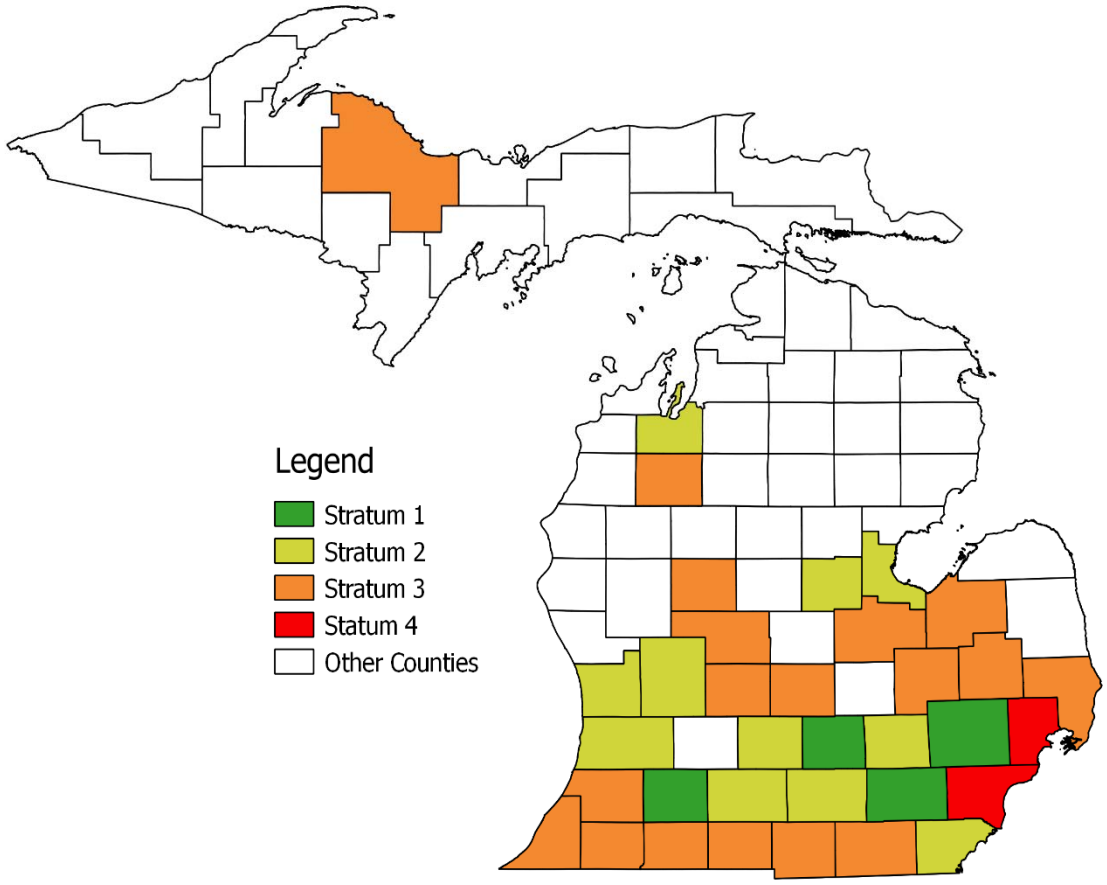

Figure 1: 35-County Sample for the Direct Observation Safety Belt Surveys

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 0.2 percent in 2017) via observed sample sizes of approximately 25,000 vehicles. Since the proposed design for the 2018 Annual survey was similar to the 2017 survey, it was expected that the sample size for the 2018 Annual Survey would be similar to the 2017 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 2018 Annual Direct Observation Survey of Safety Belt Use. It should be noted that no observations were recorded at site 152 (Riker Road and Island Lake Road in Washtenaw 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, 2016 (in 1,000s)

Belt Use Stratum	Road Class			Total
	Primary	Secondary	Local	
1	7,806,660	11,446,321	2,222,223	**21,475,204**
2	8,142,476	12,010,771	1,810,510	**21,963,757**
3	5,622,677	11,600,045	1,926,513	**19,149,235**
4	7,904,825	11,749,975	2,369,860	**22,024,660**
Statewide	**29,476,638**	**46,807,112**	**8,329,106**	**84,612,856**

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 2016.

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 298 non-response observations which represents approximately 1.4 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 29, and Tuesday, June 12, 2018. During this observation period, a total of 16,753 vehicles were observed resulting in 20,552 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 2018 was found to be 93.4 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. It should be noted that there were two instances where the original site was unobservable (sites 139 and 141), and the assigned alternate sites were used for these locations as per the study design.

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

Observational Wave	Safety Belt Use Rate*	Standard Error
Annual	93.4% ± 0.8%	0.4%

* 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	16,738	15,628	93.4%
Passengers	3,814	3,582	93.9%
Total	**20,552**	**19,210**	**93.5%**

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	23	11.5%	2661	12.9%
Monday	46	23.0%	4153	20.2%
Tuesday	33	16.5%	3477	16.9%
Wednesday	25	12.5%	2619	12.7%
Thursday	25	12.5%	2648	12.9%
Friday	18	9.0%	2094	10.2%
Saturday	30	15.0%	2900	14.1%
Total	**200**	**100.0%**	**20,552**	**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	10	5.0%	711	3.5%
8 am – 9 am	14	7.0%	1,153	5.6%
9 am – 10 am	13	6.5%	1,104	5.4%
10 am – 11 am	18	9.0%	1,785	8.7%
11 am – 12 pm	21	10.5%	2,266	11.0%
12 pm – 1 pm	24	12.0%	2,660	12.9%
1 pm – 2 pm	29	14.5%	2,551	12.4%
2 pm – 3 pm	21	10.5%	1,925	9.4%
3 pm – 4 pm	16	8.0%	2,093	10.2%
4 pm – 5 pm	14	7.0%	1,598	7.8%
5 pm – 6 pm	11	5.5%	1,429	7.0%
6 pm – 7 pm	9	4.5%	1,277	6.2%
Total	**200**	**100.0%**	**20,552**	**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	1,125	1,045	92.9%
Kalamazoo County	900	846	94.0%
Oakland County	2,318	2,144	92.5%
Washtenaw County	1,132	1,037	91.6%
Total	**5,475**	**5,072**	**92.6%**
STRATUM 2	**Actual Total No. of Observations**	**Actual Belted No. of Observations**	**% Safety Belt Use**
Allegan County	576	554	96.2%
Bay County	288	270	93.8%
Calhoun County	262	248	94.7%
Eaton County	596	542	90.9%
Grand Traverse County	385	369	95.8%
Jackson County	1,149	1,091	95.0%
Kent County	1033	972	94.1%
Livingston County	322	316	98.1%
Midland County	214	197	92.1%
Monroe County	352	330	93.8%
Ottawa County	188	178	94.7%
Total	**5,365**	**5,067**	**94.4%**
STRATUM 3	**Actual Total No. of Observations.**	**Actual Belted No. of Observations**	**% Safety Belt Use**
Berrien County	264	243	92.0%
Branch County	78	76	97.4%
Cass County	270	252	93.3%
Clinton County	119	110	92.4%
Genesee County	518	469	90.5%
Hillsdale County	96	86	89.6%
Ionia County	269	249	92.6%
Lapeer County	232	208	89.7%
Lenawee County	267	244	91.4%
Marquette County	599	578	96.5%
Mecosta County	43	42	97.7%
Montcalm County	151	146	96.7%
Saginaw County	450	426	94.7%
St. Clair County	271	260	95.9%
St. Joseph County	152	142	93.4%
Tuscola County	196	183	93.4%
Van Buren County	783	737	94.1%
Wexford County	215	207	96.3%
Total	**4,973**	**4,658**	**93.7%**
STRATUM 4	**Actual Total No. of Observations**	**Actual Belted No. of Observations**	**% Safety Belt Use**
Macomb County	4,973	4,658	93.7%
Wayne County	2,092	1,942	92.8%
Total	**2,647**	**2,471**	**93.4%**
Grand Total (Unweighted)	**20,552**	**19,210**	**93.5%**

Stratum 2 displayed the highest safety belt use rate at 94.4 percent, followed by Strata 3 and 4. Stratum 1 displayed the lowest safety belt use rate at 92.6 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	2,661	2,537	95.3%
Monday	4,153	3,846	92.6%
Tuesday	3,477	3,251	93.5%
Wednesday	2,619	2,393	91.4%
Thursday	2,648	2,486	93.9%
Friday	2,094	1,962	93.7%
Saturday	2,900	2,735	94.3%
Total	**20,552**	**19,210**	**93.5%**
Time of the Day	**Actual Total No. of Observations**	**Actual Belted No. of Observations**	**% Safety Belt Use**
7 am – 8 am	711	661	93.0%
8 am – 9 am	1,153	1,054	91.4%
9 am – 10 am	1,104	1,042	94.4%
10 am – 11 am	1,785	1,679	94.1%
11 am – 12 pm	2,266	2,113	93.2%
12 pm – 1 pm	2,660	2,449	92.1%
1 pm – 2 pm	2,551	2,410	94.5%
2 pm – 3 pm	1,925	1,797	93.4%
3 pm – 4 pm	2,093	1,958	93.5%
4 pm – 5 pm	1,598	1,508	94.4%
5 pm – 6 pm	1,429	1,335	93.4%
6 pm – 7 pm	1,277	1,204	94.3%
Total	**20,552**	**19,210**	**93.5%**
Vehicle Type	**Actual Total No. of Observations**	**Actual Belted No. of Observations**	**% Safety Belt Use**
Passenger Cars	7,523	7,029	93.4%
Sport Utility Vehicles	7,502	7,119	94.9%
Vans/Minivans	1,920	1,820	94.8%
Pick-Up Trucks	3,607	3,242	89.9%
Total	**20,552**	**19,210**	**93.5%**
Gender	**Actual Total No. of Observations**	**Actual Belted No. of Observations**	**% Safety Belt Use**
Male	11,173	10,312	92.3%
Female	9,331	8,854	94.9%
Unknown	48	44	91.7%
Total	**20,552**	**19,210**	**93.5%**
Age	**Actual Total No. of Observations**	**Actual Belted No. of Observations**	**% Safety Belt Use**
0 - 15	335	314	93.7%
16 - 29	5,562	5,112	91.9%
30 - 59	11,537	10,841	94.0%
60+	3,106	2,931	94.4%
Unknown	12	12	100.0%
Total	**20,552**	**19,210**	**93.5%**
Race	**Actual Total No. of Observations**	**Actual Belted No. of Observations**	**% Safety Belt Use**
White	17,230	16,154	93.8%
Black	2,226	2,026	91.0%
Other	1,060	999	94.2%
Unknown	36	31	86.1%
Total	**20,552**	**19,210**	**93.5%**

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	942	897	95.2%
Monday	1,566	1,453	92.8%
Tuesday	1,334	1,252	93.9%
Wednesday	916	834	91.0%
Thursday	906	858	94.7%
Friday	789	737	93.4%
Saturday	1,070	998	93.3%
Total	**7,523**	**7,029**	**93.4%**
Time of the Day	**Actual Total No. of Observations**	**Actual Belted No. of Observations**	**% Safety Belt Use**
7 am – 8 am	277	261	94.2%
8 am – 9 am	428	395	92.3%
9 am – 10 am	388	362	93.3%
10 am – 11 am	578	538	93.1%
11 am – 12 pm	835	785	94.0%
12 pm – 1 pm	1,039	963	92.7%
1 pm – 2 pm	906	857	94.6%
2 pm – 3 pm	745	699	93.8%
3 pm – 4 pm	829	766	92.4%
4 pm – 5 pm	554	520	93.9%
5 pm – 6 pm	510	475	93.1%
6 pm – 7 pm	434	408	94.0%
Total	**7,523**	**7,029**	**93.4%**
Gender	**Actual Total No. of Observations**	**Actual Belted No. of Observations**	**% Safety Belt Use**
Male	3,933	3,656	93.0%
Female	3,569	3,355	94.0%
Unknown	21	18	85.7%
Total	**7,523**	**7,029**	**93.4%**
Age	**Actual Total No. of Observations**	**Actual Belted No. of Observations**	**% Safety Belt Use**
0 - 15	100	96	96.0%
16 - 29	2,692	2,471	91.8%
30 – 59	3,609	3,399	94.2%
60+	1,113	1,054	94.7%
Unknown	9	9	100.0%
Total	**7,523**	**7,029**	**93.4%**
Race	**Actual Total No. of Observations**	**Actual Belted No. of Observations**	**% Safety Belt Use**
White	5,960	5,603	94.0%
Black	1,153	1,042	90.4%
Other	398	372	93.5%
Unknown	12	12	100.0%
Total	**7,523**	**7,029**	**93.4%**

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	1,000	964	96.4%
Monday	1,410	1,330	94.3%
Tuesday	1,231	1,156	93.9%
Wednesday	1,013	945	93.3%
Thursday	1,029	982	95.4%
Friday	737	700	95.0%
Saturday	1,082	1,042	96.3%
Total	**7,502**	**7,119**	**94.9%**
Time of the Day	**Actual Total No. of Observations**	**Actual Belted No. of Observations**	**% Safety Belt Use**
7 am – 8 am	268	255	95.1%
8 am – 9 am	423	388	91.7%
9 am – 10 am	384	369	96.1%
10 am – 11 am	677	654	96.6%
11 am – 12 pm	827	783	94.7%
12 pm – 1 pm	928	860	92.7%
1 pm – 2 pm	888	849	95.6%
2 pm – 3 pm	663	622	93.8%
3 pm – 4 pm	720	683	94.9%
4 pm – 5 pm	620	596	96.1%
5 pm – 6 pm	596	566	95.0%
6 pm – 7 pm	508	494	97.2%
Total	**7,502**	**7,119**	**94.9%**
Gender	**Actual Total No. of Observations**	**Actual Belted No. of Observations**	**% Safety Belt Use**
Male	3,324	3,110	93.6%
Female	4,165	3,997	96.0%
Unknown	13	12	92.3%
Total	**7,502**	**7,119**	**94.9%**
Age	**Actual Total No. of Observations**	**Actual Belted No. of Observations**	**% Safety Belt Use**
0 - 15	143	134	93.7%
16 - 29	1,771	1,650	93.2%
30 – 59	4,414	4,209	95.4%
60+	1,171	1,123	95.9%
Unknown	3	3	100.0%
Total	**7,502**	**7,119**	**94.9%**
Race	**Actual Total No. of Observations**	**Actual Belted No. of Observations**	**% Safety Belt Use**
White	6,334	6,031	95.2%
Black	732	672	91.8%
Other	422	404	95.7%
Unknown	14	12	85.7%
Total	**7,502**	**7,119**	**94.9%**

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	266	258	97.0%
Monday	422	396	93.8%
Tuesday	327	310	94.8%
Wednesday	259	240	92.7%
Thursday	218	202	92.7%
Friday	184	177	96.2%
Saturday	244	237	97.1%
Total	**1,920**	**1,820**	**94.8%**
Time of the Day	**Actual Total No. of Observations**	**Actual Belted No. of Observations**	**% Safety Belt Use**
7 am – 8 am	47	42	89.4%
8 am – 9 am	113	106	93.8%
9 am – 10 am	126	120	95.2%
10 am – 11 am	191	182	95.3%
11 am – 12 pm	232	216	93.1%
12 pm – 1 pm	258	249	96.5%
1 pm – 2 pm	242	232	95.9%
2 pm – 3 pm	192	184	95.8%
3 pm – 4 pm	196	183	93.4%
4 pm – 5 pm	129	121	93.8%
5 pm – 6 pm	103	100	97.1%
6 pm – 7 pm	91	85	93.4%
Total	**1,920**	**1,820**	**94.8%**
Gender	**Actual Total No. of Observations**	**Actual Belted No. of Observations**	**% Safety Belt Use**
Male	1,068	1,004	94.0%
Female	847	811	95.7%
Unknown	5	5	100.0%
Total	**1,920**	**1,820**	**94.8%**
Age	**Actual Total No. of Observations**	**Actual Belted No. of Observations**	**% Safety Belt Use**
0 - 15	39	34	87.2%
16 - 29	374	355	94.9%
30 – 59	1,175	1,117	95.1%
60+	332	314	94.6%
Unknown	0	0	N/A
Total	**1,920**	**1,820**	**94.8%**
Race	**Actual Total No. of Observations**	**Actual Belted No. of Observations**	**% Safety Belt Use**
White	1,621	1,539	94.9%
Black	177	167	94.4%
Other	118	111	94.1%
Unknown	4	3	75.0%
Total	**1,920**	**1,820**	**94.8%**

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	453	418	92.3%
Monday	755	667	88.3%
Tuesday	585	533	91.1%
Wednesday	431	374	86.8%
Thursday	495	444	89.7%
Friday	384	348	90.6%
Saturday	504	458	90.9%
Total	**3,607**	**3,242**	**89.9%**
Time of the Day	**Actual Total No. of Observations**	**Actual Belted No. of Observations**	**% Safety Belt Use**
7 am – 8 am	119	103	86.6%
8 am – 9 am	189	165	87.3%
9 am – 10 am	206	191	92.7%
10 am – 11 am	339	305	90.0%
11 am – 12 pm	372	329	88.4%
12 pm – 1 pm	435	377	86.7%
1 pm – 2 pm	515	472	91.7%
2 pm – 3 pm	325	292	89.8%
3 pm – 4 pm	348	326	93.7%
4 pm – 5 pm	295	271	91.9%
5 pm – 6 pm	220	194	88.2%
6 pm – 7 pm	244	217	88.9%
Total	**3,607**	**3,242**	**89.9%**
Gender	**Actual Total No. of Observations**	**Actual Belted No. of Observations**	**% Safety Belt Use**
Male	2,848	2,542	89.3%
Female	750	691	92.1%
Unknown	9	9	100.0%
Total	**3,607**	**3,242**	**89.9%**
Age	**Actual Total No. of Observations**	**Actual Belted No. of Observations**	**% Safety Belt Use**
0 - 15	53	50	94.3%
16 - 29	725	636	87.7%
30 – 59	2,339	2,116	90.5%
60+	490	440	89.8%
Unknown	0	0	N/A
Total	**3,607**	**3,242**	**89.9%**
Race	**Actual Total No. of Observations**	**Actual Belted No. of Observations**	**% Safety Belt Use**
White	3,315	2,981	89.9%
Black	164	145	88.4%
Other	122	112	91.8%
Unknown	6	4	66.7%
Total	**3,607**	**3,242**	**89.9%**

Occupants of sport utility vehicles exhibited the highest safety belt use rate among vehicle types at 94.9 percent, followed closely by occupants of vans or minivans at 94.8 percent. Occupants of passenger cars exhibited a use rate of 93.4 percent, while occupants of pick-up trucks exhibited the lowest use rate at 89.9 percent; consistent with historical trends. Considering days of the week, Wednesdays demonstrated the lowest safety belt usage rate with 91.4 percent. Safety belt use rates were highest on Sundays with a rate of 95.3 percent. The time period of 8:00 AM to 9:00 AM exhibited a lower usage rate than all other times of the day (91.4 percent), while occupants were most likely to wear their safety belts between the hours of 1:00 PM to 2:00 PM (94.5 percent).

Female occupants had higher use rates than male occupants by 2.6 percent (94.9 percent use rate for females vs. 92.3 percent use rate for males). The safety belt usage rate was highest among occupants age 60 and above at 94.4 percent, and lowest for occupants between the ages of 16 to 29 (91.9 percent). The safety belt use rate for occupants age 0 to 15 was found to be 93.7 percent while the use rate was 94.0 percent among occupants ages 30 to 59. Considering occupant races, the safety belt use rate was found to be lowest among black occupants (91.0 percent) and highest for individuals of 'other' races (94.2 percent) which includes individuals of Asian descent and Pacific Islanders. White occupants were found to have a safety belt use rate of 93.8 percent.

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 86.5%. However it should be noted that the sample size for this group was relatively small. Similar to previous findings, white females and females of 'other' races 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 87.7% 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	138	129	93.5%
		Black	26	24	92.3%
		Other	20	20	100.0%
		Unknown	1	0	0.0%
		Total	**185**	**173**	**93.5%**
	16 - 29	White	2,071	1,886	91.1%
		Black	386	334	86.5%
		Other	247	231	93.5%
		Unknown	4	3	75.0%
		Total	**2,708**	**2,454**	**90.6%**
	30 - 59	White	5,503	5,113	92.9%
		Black	661	608	92.0%
		Other	350	325	92.9%
		Unknown	17	16	94.1%
		Total	**6,531**	**6,062**	**92.8%**
	60+	White	1,676	1,557	92.9%
		Black	49	42	85.7%
		Other	20	20	100.0%
		Unknown	0	0	N/A
		Total	**1,745**	**1,619**	**92.8%**
	Unknown	White	3	3	100.0%
		Black	1	1	100.0%
		Other	0	0	N/A
		Unknown	0	0	N/A
		Total	**4**	**4**	**100.0%**
	TOTAL		**11,173**	**10,312**	**92.3%**

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	114	108	94.7%
		Black	22	19	86.4%
		Other	12	12	100.0%
		Unknown	0	0	N/A
		Total	**148**	**139**	**93.9%**
	16 - 29	White	2,278	2,131	93.5%
		Black	374	336	89.8%
		Other	178	171	96.1%
		Unknown	2	2	100.0%
		Total	**2,832**	**2,640**	**93.2%**
	30 - 59	White	4,118	3,945	95.8%
		Black	658	617	93.8%
		Other	213	201	94.4%
		Unknown	4	3	75.0%
		Total	**4,993**	**4,766**	**95.5%**
	60+	White	1,295	1,249	96.4%
		Black	39	37	94.9%
		Other	20	19	95.0%
		Unknown	0	0	N/A
		Total	**1,354**	**1,305**	**96.4%**
	Unknown	White	2	2	100.0%
		Black	2	2	100.0%
		Other	0	0	N/A
		Unknown	0	0	N/A
		Total	**4**	**4**	**100.0%**
	TOTAL		**9,331**	**8,854**	**94.9%**

In comparison to 2017, the 2018 Annual survey revealed a slight decrease in safety belt usage from 94.1 percent to 93.4 percent; a change that is not statistically significant. 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 1. These areas should be emphasized in subsequent program efforts.

6.2 Mobile Device Use Results and Conclusions

As a part of the 2018 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 1,154 drivers were observed using a mobile device in some way and the overall weighted mobile device use rate was found to be 7.1 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 1.1 percent increase from the 6.0 percent mobile device use rate observed in Michigan in 2017. Nationally, the overall mobile device use rate by drivers was found to be 5.9 percent in 2016 [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 7.1 percent is slightly higher than the national average of 5.9 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	**7.1% ± 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	16,738	664	4.0%
Talking – Hands-free Device (Earpiece Observed)	16,738	68	0.4%
Talking – Hands-free Device (Earpiece Not Observed)	16,738	40	0.2%
Typing – Hand-held	16,738	382	2.3%
Overall Mobile Device Use	**16,738**	**1154**	**6.9%**

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 (8.2 percent and 6.0 percent, respectively). The mobile device use rate was found to be highest between 4:00 pm and 5:00 pm at 7.9 percent, while the mobile device use rate was lowest between 5:00 pm and 7:00 am and 8:00 am and (5.4 percent). Mobile device use among drivers less than 30 years of age was greatest at 10.2 percent, in comparison to 6.7 percent among those between ages 30 and 59 and

1.9 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 Wednesdays (8.3%), and lowest on Sundays (3.2%). Finally, mobile device use was highest among drivers of vans/minivans (7.4%), and lowest among drivers of pickup trucks (6.1%).

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	1,851	67	3.6%
Monday	3,518	253	7.2%
Tuesday	2,959	217	7.3%
Wednesday	2,283	190	8.3%
Thursday	2,238	167	7.5%
Friday	1,749	128	7.3%
Saturday	2,140	132	6.2%
Total	**16,738**	**1,154**	**6.9%**
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	626	34	5.4%
8 am - 9 am	992	63	6.4%
9 am - 10 am	920	65	7.1%
10 am - 11 am	1,438	92	6.4%
11 am - 12 pm	1,848	108	5.8%
12 pm - 1 pm	2,148	165	7.7%
1 pm - 2 pm	2,021	135	6.7%
2 pm - 3 pm	1,592	115	7.2%
3 pm - 4 pm	1,667	115	6.9%
4 pm - 5 pm	1,334	106	7.9%
5 pm - 6 pm	1,138	88	7.7%
6 pm - 7 pm	1,014	68	6.7%
Total	**16,738**	**1,154**	**6.9%**

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	6,248	424	6.8%
Sport Utility Vehicles	6,060	439	7.2%
Vans/ Minivans	1,508	112	7.4%
Pick-Up Trucks	2,922	179	6.1%
Total	**16,738**	**1,154**	**6.9%**
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	9,786	585	6.0%
Female	6,917	565	8.2%
Unknown	35	4	11.4%
Total	**16,738**	**1,154**	**6.9%**
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	4,400	447	10.2%
30-59	9,914	661	6.7%
60+	2,415	45	1.9%
Unknown	9	1	11.1%
Total	**16,738**	**1,154**	**6.9%**
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	14,046	873	6.2%
Black	1,854	220	11.9%
Other	809	56	6.9%
Unknown	29	5	17.2%
Total	**16,738**	**1,154**	**6.9%**

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3. Blincoe, L. J., Miller, T. R., Zaloshnja, E., Lawrence, B. A. The Economic and Societal Impact of Motor Vehicle Crashes, 2010 (Revised). Washington, DC: National Highway Traffic Safety Administration, 2015.
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APPENDIX I
Michigan Safety Belt Survey Cover Sheet and Data Collection Form

DIRECT OBSERVATION SURVEY COVER SHEET

Date: _____ - _____ - 2018 **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 eight 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.A., Civil Engineering, Michigan State University, 2000
B.S., Civil Engineering, Michigan State University, 2000

Professional Associations

American Society of Civil Engineers
Institute of Transportation Engineers

Computer Skills

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

Relevant Project Experience

Wayne State University (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 Associate Professor in the Iowa State University Department of Civil, Construction, and Environmental Engineering. Dr. Savolainen serves as the lead statistical advisor for this project. Prior to joining Iowa State University in 2014, he was an Associate Professor of Civil Engineering at Wayne State University. He has more than nine 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.A., 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

Wayne State University (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, and 2015.

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	122	128	140977.3
1	INGHAM	I-96 and N. Williamston Road (Exit 117A)	Original	Primary	45	47	16167.9
1	INGHAM	I-96 and Stockbridge Road (M-43)	Original	Primary	71	83	26619.4
1	KALAMAZOO	I-94 and Oakland Drive	Original	Primary	163	170	80134.1
1	KALAMAZOO	I-94 and S. 9th Street	Original	Primary	156	163	137485.8
1	OAKLAND	I-75 and Baldwin Road	Original	Primary	126	131	64018.8
1	OAKLAND	I-75 and Ortonville Road (M-15)	Original	Primary	77	83	118362.0
1	OAKLAND	I-75 and Grange Hall Road	Original	Primary	103	114	30840.5
1	OAKLAND	I-96 and Milford Road	Original	Primary	147	153	33973.2
1	OAKLAND	I-75 (Chrysler Fwy) and Twelve Mile Road	Original	Primary	107	118	25376.7
1	OAKLAND	I-696 (Walter P Reuther Fwy) and Greenfield Road	Original	Primary	128	147	67878.0
1	OAKLAND	I-96 and Wixom Road North	Original	Primary	129	134	48390.8
1	WASHTENAW	I-94 and Rawsonville Road	Original	Primary	118	134	50756.3
1	WASHTENAW	I-94 and S. Huron Street	Original	Primary	89	95	175297.7
1	WASHTENAW	I-94 and Chelsea Manchester Road (M-52)	Original	Primary	83	91	42926.1
1	INGHAM	E. Saginaw St (M-43) and Marshall Street	Original	Secondary	121	130	74611.7
1	INGHAM	Old U.S. 27 (N. Larch St) and Lake Lansing Road / Douglas Ave	Original	Secondary	99	112	139133.5
1	INGHAM	M-52 (W. Main St.) and S. M-106 (Clinton St.)	Original	Secondary	154	162	26385.0
1	INGHAM	US-127 and Holt Road	Original	Secondary	90	93	24921.3
1	INGHAM	US-127 and Cedar Street (M-36)	Original	Secondary	77	84	24558.6
1	INGHAM	US-127 and W. Barnes Road	Original	Secondary	72	74	18262.8
1	INGHAM	Perry Rd (M-52) and E. Grand River Avenue (M-43)	Original	Secondary	102	109	21342.4
1	INGHAM	Stockbridge Rd (M-43) and E. Grand River Avenue (M-43)	Original	Secondary	92	103	32798.8
1	KALAMAZOO	Michigan Ave (M-96) and 35th Street	Original	Secondary	137	157	49315.1
1	KALAMAZOO	Bus US-131 and Douglas Avenue	Original	Secondary	34	35	17198.3
1	KALAMAZOO	US-131 and W. U Avenue	Original	Secondary	124	129	46267.8
1	KALAMAZOO	E. D Ave and N. 32nd Street (M-89)	Original	Secondary	100	110	40781.6
1	KALAMAZOO	M-89 and N. 34th Street	Original	Secondary	132	136	38207.0
1	OAKLAND	S Lapeer Rd (M-24) and Drahner Road	Original	Secondary	120	135	92029.3
1	OAKLAND	Highland Rd (M-59) and N. Milford Road	Original	Secondary	120	127	67198.9
1	OAKLAND	E 8 Mile Rd (M-102) and John R Road	Original	Secondary	150	159	103552.3
1	OAKLAND	Telegraph Rd (US-24) and Quarton Road	Original	Secondary	142	147	196573.2
1	OAKLAND	Highland Rd (M-59) and Airport Road	Original	Secondary	163	181	87549.2
1	OAKLAND	Bus I- 75 (N. Perry St.) and Glenwood Ave	Original	Secondary	168	189	88323.9
1	OAKLAND	W Square Lake Rd (Bus US-24) and Franklin Road	Original	Secondary	156	168	141774.9
1	OAKLAND	Woodward Ave (M-1) and E. Long Lake Road	Original	Secondary	148	158	212597.7
1	WASHTENAW	M-52 (Ann Arbor St.) and E. Main Street	Original	Secondary	93	105	39175.6
1	WASHTENAW	Ecorse Rd (M-17) and S. Ford Blvd. / Dorset Ave	Original	Secondary	89	103	156092.2
1	WASHTENAW	US-23 and W. Michigan Ave (US-12)	Original	Secondary	82	88	28522.4
1	WASHTENAW	US-23 and E. Willis Road	Original	Secondary	57	64	25078.2
1	WASHTENAW	Main St. (M-52) and Middle Street	Original	Secondary	87	94	50045.7
1	WASHTENAW	M-14 and Whitmore Lake Road	Original	Secondary	96	100	41439.5
1	WASHTENAW	M-14 (Exit 2) and Maple Road	Original	Secondary	96	102	86840.6
1	WASHTENAW	M-14 and Gotfredson Road	Original	Secondary	51	52	79690.3
1	WASHTENAW	M-153 (Exit 10 from M-14) and Plymouth Road	Original	Secondary	82	86	66707.1
1	OAKLAND	W Rutland St and 13 Mile Road	Original	Local	6	6	1822658.8
1	OAKLAND	Glengary Rd and S. Commerce Road	Original	Local	139	150	2573268.6
1	OAKLAND	Standard St and Crescent Lake Road	Original	Local	15	18	1706159.2
1	WASHTENAW	Riker Road and Island Lake Road	Original	Local	0	0	0.0
1	WASHTENAW	Coyle Road and 6 Mile Road/Whitmore Lake Road	Original	Local	14	18	1843158.2

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	26	27	44485.2
2	ALLEGAN	I-196 and Lincoln Road (M-40)	Original	Primary	107	110	58110.9
2	BAY	I-75 (US-23) and E. Beaver Road	Original	Primary	88	94	36406.3
2	CALHOUN	I-69 and Michigan Avenue (M-96)	Original	Primary	90	93	54761.1
2	CALHOUN	I-94 and C Drive N	Original	Primary	92	99	38533.2
2	CALHOUN	I-94 and 26 Mile Rd. (M-199)	Original	Primary	24	24	32615.1
2	CALHOUN	I-69 and N. Drive N / Turkeyville Rd.	Original	Primary	35	36	29649.3
2	EATON	I-69 and Ainger Road	Original	Primary	15	17	29652.2
2	EATON	I-69 and S. Cochran Ave (Bus I-69)	Original	Primary	57	63	37831.8
2	EATON	I-69 and W. Saginaw Hwy (M-43)	Original	Primary	105	119	65432.8
2	JACKSON	I-94 and N. Dearing Road	Original	Primary	16	16	29645.8
2	JACKSON	I-94 and N. Elm Ave	Original	Primary	127	135	34272.9
2	JACKSON	I-94 and Mt. Hope Road	Original	Primary	128	131	35107.5
2	LIVINGSTON	I-96 and Grand River Ave	Original	Primary	164	167	89498.6
2	OTTAWA	I-196 (Gerald Ford Fwy) and 32nd Ave	Original	Primary	68	73	29664.8
2	ALLEGAN	US-131 and 142nd Ave	Original	Secondary	139	149	72923.5
2	ALLEGAN	US-131 and W. Superior Street	Original	Secondary	61	62	271435.3
2	ALLEGAN	Lincoln Rd (M-40) and I-196 (Gerald R. Ford Fwy)	Original	Secondary	114	117	144676.0
2	ALLEGAN	Lincoln Rd (M-40) and Interchange Drive	Original	Secondary	107	111	119846.1
2	BAY	M-25 (W. Jenny St) and S. Euclid Ave (M-13)	Original	Secondary	137	146	123641.3
2	BAY	M-47 and W. Salzburg Road	Original	Secondary	45	48	40276.9
2	EATON	Cochran Ave (Bus I- 69) and W. Shepherd Street / Upland Ave	Original	Secondary	152	157	93837.1
2	EATON	W. Saginaw Hwy (M-43) and I-69 North Ramp	Original	Secondary	107	127	241161.4
2	EATON	M-43 (W. Saginaw Hwy) and Jenne Street	Original	Secondary	106	113	104633.0
2	GRAND TRAVERSE	US-31 and S. South Long Lake (M-137)	Original	Secondary	168	174	136808.2
2	GRAND TRAVERSE	E Traverse Hwy (M-72) and S. Bugai Road/Gray Road	Original	Secondary	201	211	53322.5
2	JACKSON	Wamplers Lake Rd. (M-124) and S. Main Street (M-50)	Original	Secondary	87	100	106702.2
2	JACKSON	US-127 and I-94 West Ramp	Original	Secondary	86	89	534024.7
2	JACKSON	Clinton Rd (M-50) and Rives Junction Road	Original	Secondary	92	97	67121.5
2	JACKSON	Eaton Rapids Rd (M-99) and E. Main Street	Original	Secondary	68	73	44347.3
2	JACKSON	Brooklyn Rd (M-50) and US-127 NB Ramps	Original	Secondary	195	203	69429.6
2	JACKSON	US-127 and Page Ave	Original	Secondary	178	186	71013.4
2	KENT	US-131 and 17 Mile Road NE (M-46)	Original	Secondary	134	137	137543.2
2	KENT	Belding Rd NE (M-44) and Wolverine Blvd NE (M-44)	Original	Secondary	115	123	116454.4
2	KENT	Alpine Ave NW (M-37) and Lamoreaux Dr. NW	Original	Secondary	135	143	437429.5
2	KENT	US-131 and Ann St. NW	Original	Secondary	110	125	134279.0
2	KENT	Paul B. Henry Fwy (M-6) and Byron Center Ave SW	Original	Secondary	117	123	130707.5
2	KENT	M-6 (Paul B. Henry Fwy) and Wilson Ave SW	Original	Secondary	108	111	47714.6
2	KENT	US-131 and 84th Street SW	Original	Secondary	161	169	236685.1
2	LIVINGSTON	US-23 and Silver Lake Road	Original	Secondary	136	138	55846.8
2	MIDLAND	US-10 and N. Stark Road	Original	Secondary	43	47	36529.6
2	MIDLAND	US-10 and Waldo Ave	Original	Secondary	154	167	49704.2
2	MONROE	N. Monroe St (M-125) and Stewart Road	Original	Secondary	152	160	173224.0
2	MONROE	S. Telegraph Rd (US-24) and W. Albian Road	Original	Secondary	147	155	145288.6
2	OTTAWA	Chicago Dr (M-121) and 48th Ave	Original	Secondary	110	115	117313.4
2	CALHOUN	2 Mile Rd / Collier Ave and Meachem Road / U Dr N	Original	Local	7	10	3210878.9
2	JACKSON	W High St and S W. Ave	Original	Local	114	119	4133870.9
2	KENT	Clay Ave SW and 36th Street	Original	Local	92	102	7473282.1
2	LIVINGSTON	Dutcher Rd and Lange Road	Original	Local	16	17	3401425.4
2	MONROE	Oakdale Ave and Douglas Road	Original	Local	31	37	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	51	54	32580.4
3	BERRIEN	I-94 and M-140 (S. Main St.)	Original	Primary	64	66	35228.6
3	BRANCH	I-69 and Jonesville Road	Original	Primary	76	78	49289.0
3	GENESEE	I-75/US-23 and Corunna Road (M-21)	Original	Primary	115	128	101130.0
3	GENESEE	I-75/US-23 and Miller Road	Original	Primary	98	107	67293.2
3	LAPEER	I-69 and Van Dyke Road (M-53)	Original	Primary	86	92	124992.4
3	SAGINAW	I-75 (US-23) and Dixie Highway	Original	Primary	54	55	40301.5
3	SAGINAW	I-75 (US-23) and Bay City Road (M-13)	Original	Primary	101	105	48786.6
3	SAGINAW	I-675 and Davenport Ave (M-58)	Original	Primary	162	172	166014.7
3	ST. CLAIR	I-94 and Fred W. Moore Hwy	Original	Primary	52	56	71199.9
3	ST. CLAIR	I-94 and Range Road	Original	Primary	84	87	68641.9
3	VAN BUREN	I-94 and County Road 687	Original	Primary	70	78	37418.9
3	VAN BUREN	I-196/US-31 and M-140 (Bus I-196)	Original	Primary	56	60	34461.7
3	VAN BUREN	I-196 and Phoenix Street	Original	Primary	86	94	38949.8
3	VAN BUREN	I-94 and N. County Road 365	Original	Primary	32	33	31240.0
3	BERRIEN	N. 5th Street (M-51) and Sycamore Street	Original	Secondary	128	144	134321.8
3	CASS	M 51 (N. Front St.) and Prairie Ronde Street	Original	Secondary	56	63	74178.4
3	CASS	M-62 and Main Street (US-12)	Original	Secondary	124	129	120661.9
3	CLINTON	US-127 and Old US 27 / State Rd.	Original	Secondary	11	12	69355.9
3	CLINTON	W. M 21 and S. Main Street	Original	Secondary	99	107	78018.3
3	GENESEE	N. State Road (M-15) and E. Dodge Road	Original	Secondary	74	84	252428.5
3	GENESEE	Sheridan Road (M-13) and Vienna Road (M-57)	Original	Secondary	98	106	151568.3
3	GENESEE	Sheridan Road (M-13) and Corunna Road (M-21)	Original	Secondary	84	93	106860.2
3	HILLSDALE	US-127 (Meridian Rd.) and Main Street / Hudson Rd.	Original	Secondary	86	96	139262.9
3	IONIA	Bluewater Hwy (M-21) and N. State Street (M-66)	Original	Secondary	112	122	171645.3
3	IONIA	S State Rd (M-66) and W. Tuttle Road	Original	Secondary	137	147	420528.1
3	LAPEER	E Burnside Rd (M-90) and N. Van Dyke Road (M-53)	Original	Secondary	79	89	88225.5
3	LENAWEE	US-12 and M-50	Original	Secondary	109	124	350342.9
3	LENAWEE	US-223 (W. Adrian St.) and Monroe Street	Original	Secondary	135	143	286753.3
3	MARQUETTE	US-41 and Cherry Creek Road (M-28)	Original	Secondary	153	163	109241.9
3	MARQUETTE	M-553 and County Road 480	Original	Secondary	180	182	119483.2
3	MARQUETTE	S. Front St (M-28/US-41) and Genesee/S. Lakeshore Blvd	Original	Secondary	245	254	265445.7
3	MECOSTA	US-131 and Jefferson Road	Original	Secondary	42	43	66411.9
3	MONTCALM	US-131/M-46 and Cannonsville Road	Original	Secondary	29	30	69336.8
3	MONTCALM	Howard City Edmore Rd (M-46) and M-66 (6 Lakes Rd.)	Original	Secondary	103	105	192318.2
3	SAGINAW	Gratiot Road (M-46) and Center Road	Original	Secondary	109	118	271621.6
3	ST. JOSEPH	M-60 and US-131 South	Original	Secondary	119	124	130035.7
3	TUSCOLA	Bay Street (M-25) and Center Street (M-24)	Original	Secondary	89	98	90464.3
3	TUSCOLA	Sanilac Road (M-46) and Saginaw Road (M-15)	Original	Secondary	94	98	82690.7
3	VAN BUREN	M-51 (Deleware St.) and Phelps Street	Original	Secondary	120	128	256162.3
3	VAN BUREN	M-51 (43rd St.) and W. Red Arrow Highway	Original	Secondary	137	142	116487.5
3	VAN BUREN	M-40 (Kalamazoo St.) and W. Michigan Avenue	Original	Secondary	103	108	265107.8
3	VAN BUREN	M-43 and M-40	Original	Secondary	133	140	243083.8
3	WEXFORD	US-131 and W. 16 Rd (Bus US-131/M-42)	Original	Secondary	52	53	59968.1
3	WEXFORD	M-115 and W. 13th Street	Original	Secondary	155	162	136488.0
3	CASS	Calvin Center Road and US-12	Original	Local	72	78	5062416.2
3	LAPEER	Brown City Rd and E. Burnside Road (M-90)	Original	Local	43	51	4555653.3
3	MONTCALM	Keeney Rd and Waterwheel Road	Original	Local	13	13	3193351.4
3	MONTCALM	S. County Line Rd. and Blackner/O'Brien Road	Original	Local	1	3	4035314.5
3	ST. JOSEPH	Lake Rd and Eagley Road	Original	Local	23	28	4746431.6

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	32	33	43487.0
4	MACOMB	E. Eleven Mile Rd (I-696 Service Drive) and Van Dyke (M-53)	Original	Primary	93	101	103046.3
4	MACOMB	I-94 and 16 Mile Road	Original	Primary	111	118	118437.6
4	WAYNE	I-275 and Sibley Road	Original	Primary	50	53	74839.4
4	WAYNE	I-275 and Eureka Road	Original	Primary	40	41	99317.2
4	WAYNE	I-75 and Eureka Road	Original	Primary	49	51	19217.5
4	WAYNE	I- 96 (Jeffries Fwy Service Dr/Schoolcraft) and Beech Daly	Original	Primary	171	185	65057.7
4	WAYNE	Chrysler Fwy Service Drive (I-75) and Warren Ave	Original	Primary	51	53	72982.1
4	WAYNE	I-94 (Harper Ave/Ford Fwy Service Drive) and Allard Ave	Original	Primary	37	39	66766.4
4	WAYNE	Fisher Fwy Service Dr (I-75) and Springwell Street	Alternate	Primary	80	95	94842.7
4	WAYNE	I-94 and Enterprise Drive	Original	Primary	47	49	21688.8
4	WAYNE	Fisher Fwy Service Dr (I-75) and Clark Ave	Alternate	Primary	15	16	59338.0
4	WAYNE	I-275 and Ecorse Road	Original	Primary	38	39	142080.0
4	WAYNE	I-275 and Ann Arbor Road	Original	Primary	83	85	98140.9
4	WAYNE	I- 75 and Sibley Rd	Original	Primary	10	13	70668.4
4	MACOMB	23 Mile Rd (M-29) and Jefferson Ave	Original	Secondary	69	77	59800.5
4	MACOMB	Gratiot Ave (M-19) and 31 Mile Road	Original	Secondary	142	146	27348.4
4	MACOMB	Van Dyke and 28 Mile Road	Original	Secondary	89	100	83063.2
4	MACOMB	M-53 (Van Dyke Fwy) and Van Dyke Rd	Original	Secondary	99	109	98718.0
4	MACOMB	23 Mile Rd (M-29) and Donner Road/I-94 East Ramp	Original	Secondary	146	157	128926.4
4	MACOMB	M-53 (Van Dyke Fwy) and 23 Mile Road	Original	Secondary	121	129	53062.4
4	MACOMB	Dobry Dr. (M-59 Service Drive) and Mound Road	Original	Secondary	90	94	144115.3
4	MACOMB	M-53 (Van Dyke Fwy) and M-59 (Hall Rd.)	Original	Secondary	125	131	45208.3
4	MACOMB	Hall Rd (M-59) and Schoenherr Road	Original	Secondary	95	102	160869.2
4	MACOMB	Hall Rd (M-59) and Westbrook Drive	Original	Secondary	141	149	151294.6
4	MACOMB	Northbound Gratiot Ave (M-3) and Market Street	Original	Secondary	97	108	79372.3
4	MACOMB	Gratiot Ave (M-3) and Utica Road	Original	Secondary	78	90	101764.2
4	MACOMB	Van Dyke (M-53) and Chicago Road	Original	Secondary	116	124	114801.4
4	MACOMB	Van Dyke (M-53) and 15 Mile Road	Original	Secondary	171	177	92513.6
4	WAYNE	Telegraph Rd (US-24) and Goddard Road	Original	Secondary	153	161	127022.2
4	WAYNE	Vernier Rd (M-102) and E. 8 Mile Road	Original	Secondary	127	143	79383.8
4	WAYNE	Groesbeck Hwy (M-97) and 8 Mile Rd (M-102)	Original	Secondary	84	86	37182.9
4	WAYNE	M-14 and Sheldon Rd	Original	Secondary	195	206	58561.7
4	WAYNE	Grand River Ave and Lodge Fwy/M-10 Service Drive	Original	Secondary	87	89	44608.8
4	WAYNE	John C Lodge Fwy (M-10 Service Drive) and Grand River Ave	Original	Secondary	59	63	86534.2
4	WAYNE	Michigan Ave (US-12) and Rosa Parks Blvd	Original	Secondary	65	68	112086.0
4	WAYNE	Michigan Ave (US-12) and 14th St/Vernor Hwy/Fisher Svc Dr	Original	Secondary	30	34	47322.5
4	WAYNE	Michigan Ave (US-12) and Haggerty Road	Original	Secondary	78	81	90519.8
4	WAYNE	Ford Rd (M-153) and N. Canton Center Road	Original	Secondary	74	78	111781.0
4	WAYNE	Southfield Rd (M-39) and Allen Rd	Original	Secondary	54	56	121520.5
4	WAYNE	Fort St (M-85) and Northline Rd	Original	Secondary	150	160	148065.6
4	WAYNE	Telegraph Rd (US-24) and King Rd	Original	Secondary	115	124	40056.1
4	WAYNE	Grand River Ave (M-5) and Outer Drive W	Original	Secondary	145	166	80607.8
4	WAYNE	Telegraph Rd and Grand River Ave (M-5)	Original	Secondary	144	160	117457.2
4	WAYNE	Telegraph Rd and Six Mile/McNichols	Original	Secondary	153	159	257951.9
4	MACOMB	Commons Drive and 23 Mile Road	Original	Local	9	9	1373693.6
4	MACOMB	Walnut Creek Dr and 22 Mile Road	Original	Local	79	88	1500391.8
4	MACOMB	25 Mile Rd and Hayes Road	Original	Local	163	178	5105206.4
4	WAYNE	W Jefferson Ave and Van Horn Road	Original	Local	58	58	6578073.7
4	WAYNE	Pine St and Middlebelt Rd	Original	Local	29	36	1838409.5