DIRECT OBSERVATION OF SAFETY BELT USE IN MINNESOTA: AUGUST 2004

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INTRODUCTION

In 1983, belt use in the United States was only 14 percent (Haseltine, 2001). This extremely low belt use rate was not due to a lack of available restraint systems in vehicles. Safety belt systems have been installed in all cars manufactured in the U.S. since 1964, with combination lap/shoulder belts installed in all U.S. cars since 1968 (Haseltine, 2001). Understanding the safety benefits of belt use rate, traffic safety professionals tried several means to convince the motoring public to buckle-up. The earliest of these efforts relied on advertising campaigns focusing on educating the public about the value of safety belts. These purely educational activities were largely unsuccessful. The next attempt at increasing safety belt use began in 1974 with the introduction of a requirement for all new cars to have ignition interlock devices. These devices prevented the vehicle from being started until the driver was wearing his or her safety belt. While these devices were successful at increasing the belt use rate for equipped vehicles, the public outcry against the interlock device led Congress to repeal the law.

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

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

Near the end of the 1990s, however, the level of belt use in most states had reached a plateau at around 65 to 70 percent. At this point, experts believed that the most effective way for a state to continue to increase safety belt use was to re-examine its safety belt law and make a legislative change to allow for primary (standard) enforcement. This change was necessary because most of the original MULs implemented at the state level, including Minnesota’s law, contained a provision known as secondary enforcement. This provision only allowed police officers to stop and cite a motorist for safety belt non-use if they were observed violating some other law as well. In other words, if a motorist was otherwise complying with all other traffic laws, they could not be stopped solely for failing to buckle-up. By the end of the 1990s, there was increasing evidence that states with primary enforcement provisions had higher belt use rates, and further, the few states that had already made the change from secondary to primary enforcement had experienced a sharp increase in belt use directly related to this change.

Throughout the end of the 1990s and even today, many states continue efforts to change their respective safety belt laws to primary enforcement. Nearly every state that has made this change has noted an upward trend in belt use similar to those experienced when the MULs were first introduced in the mid-80s. Specifically, these legislative changes have been followed by an immediate sharp increase in belt use, followed by a slight decline and leveling off of the belt use rate.

Campaigns that attempt to simply educate the public are generally no longer successful since the vast majority of the public now accepts that safety belts are effective in reducing injuries and fatalities sustained in a motor vehicle crash. Current campaigns, including those in Minnesota, have changed focus and have been successful in increasing belt use by attempting to change motorists' perceived risk of receiving a citation and the perceived seriousness of the consequences related to the citation. This has been accomplished by pairing media messages such as "Click It Or Ticket" with a marked increase in police enforcement.

The purpose of the current survey is to assess continuing efforts in Minnesota to increase safety belt use statewide. The current study represents the third wave of a full statewide survey using the design developed in 2003 (Eby, Vivoda, & Cavanagh, 2003). This report documents the survey design, methods, data analysis, and results.

METHODS

Sample Design

The goal of this sample design was to select observation sites that accurately represent front-outboard vehicle occupants in eligible commercial and noncommercial vehicles (i.e., passenger cars, vans/minivans, sport-utility vehicles, and pickup trucks) in Minnesota, while following federal guidelines for safety belt survey design (NHTSA, 1992, 1998). An ideal sample minimizes total survey error while providing sites that can be surveyed efficiently and economically. To achieve this goal, NHTSA guidelines allow states to omit from their sample space the lowest population counties, provided these counties collectively account for 15 percent or less of the state's total population. Therefore, all 87 Minnesota counties were rank ordered by population (US Census Bureau, 2003) and the low population counties were eliminated from the sample space. This step reduced the sample space to 37 counties.

These 37 counties were then separated into four strata. The strata were constructed by obtaining historical belt use rates and vehicle miles of travel (VMT) for each county. Historical belt use rates were determined by examining results from three previous statewide safety belt surveys conducted in Minnesota. Since no historical data were available for 22 of the counties, belt use rates for these counties were estimated using multiple regression based on educational attainment for the other 15 counties (r^2 = .35; US Census Bureau, 2003).[1] This factor has been shown previously to correlate positively with belt use. Hennepin County was chosen as a separate stratum because of its disproportionately high VMT. Three other strata were constructed by rank ordering each county by historical belt use rates and then adjusting the stratum boundaries until the total VMT was roughly equal within each stratum. The stratum boundaries were high belt use, medium belt use, low belt use, and Hennepin County. Hennepin County VMT was slightly lower than the collective VMTs in the other strata (94%). Stratum boundaries for the sample space are shown in Table 1.

To achieve the NHTSA required precision of less than 5 percent relative error,

[1] Educational attainment was defined as the proportion of population in the county over 25 years of age with a bachelor degree.

the minimum number of observation sites for the survey was determined based on within- and between-county variances from previous belt use surveys and on an estimated 50 vehicles per observation period in the current survey. This number was then increased (N = 240) to get an adequate representation of belt use for each day of the week and for all daylight hours.

Because total VMT within each stratum was roughly equal, observation sites were evenly divided among the strata (60 each). In addition, since an estimated 29 percent of all traffic in Minnesota occurs on limited-access roadways (Federal Highway Administration, 2002), each stratum was further divided into two strata, one of which contained 17 limited access sites (exit ramps) to represent the 29% of VMT on limited access roadways and one that contained 43 roadway intersections. Thus, the sample design had a total of 8 strata.

Table 1: Listing of the Counties Within Each Stratum

Stratum	Counties
High Belt Use **Stratum 1: intersections** **Stratum 5: exit ramps**	Carver, Dakota, Olmsted, Ramsey, Wright
Hennepin **Stratum 2: intersections** **Stratum 6: exit ramps**	Hennepin
Medium Belt Use **Stratum 3: intersections** **Stratum 7: exit ramps**	Beltrami, Blue Earth, Clay, Crow Wing, Freeborn, Goodhue, Kandiyohi, Nicollet, Rice, Scott, Sherburne, St. Louis, Steele, Washington
Low Belt Use **Stratum 4: intersections** **Stratum 8: exit ramps**	Anoka, Becker, Benton, Brown, Carlton, Cass, Chisago, Douglas, Isanti, Itasca, McLeod, Morrison, Mower, Otter Tail, Polk, Stearns, Winona

Within each intersection stratum, observation sites were randomly assigned to a location using a method that ensured each intersection within a stratum an equal probability of selection. Detailed, equal-scale road maps for each county within the sample space were obtained and a grid pattern was overlaid on the maps. The lines of the grid were separated by 1/4 inch, thus creating grid squares that were about 3/4 of a mile per side. The grid patterns were created by printing a grid design onto transparencies and uniquely identifying each grid square by two numbers, a horizontal (*x*) coordinate and a vertical (*y*) coordinate. Additional grid transparencies were printed until enough were available to cover all counties within the stratum. Each transparency was numbered to allow for a simpler grid square numbering scheme.

The 43 local intersection sites were chosen by first randomly selecting a transparency number and then a random *x* and a random *y* coordinate within the identified transparency grid sheet. If a single intersection was contained within the square, that intersection was chosen as an observation site. If the square did not fall within the stratum, or there was no intersection within the square, then a new transparency number and *x*, *y* coordinate were randomly selected. If more than one intersection was within the grid square, the grid square was subdivided into four equal sections and a random number between 1 and 4 was selected until one of the intersections was chosen. Thus, each intersection within the stratum had an equal probability of selection.

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

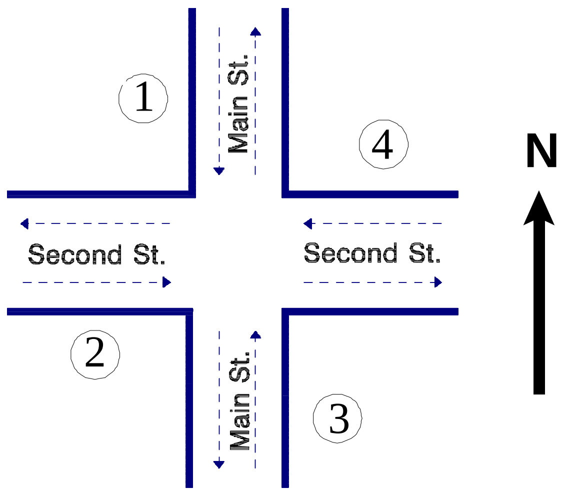

Figure 1. An Example "+" Intersection Showing 4 Possible Observer Locations.

For each primary intersection site, an alternate site was also selected. The alternate sites were chosen within a five square mile area around the grid square containing the original intersection. This was achieved by randomly picking an *x*, *y* grid coordinate within an alternate site grid transparency consisting of 7 squares horizontally by 7 squares vertically, centered around the primary site. Coordinates were selected until a grid square containing an intersection was found. The observer location at the alternate intersection was determined in the same way as at the primary site.[1]

The 17 freeway exit ramp sites for the exit ramp strata were also selected using a method that allowed equal probability of selection for each exit ramp within the stratum.[2] This was done by enumerating all of the exit ramps within a stratum and randomly

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

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

selecting, without replacement, 17 numbers between 1 and the number of exit ramps in the stratum. For example, in the low belt use stratum there were a total of 75 exit ramps; therefore a random number between 1 and 75 was generated. This number corresponded to a specific exit ramp within the stratum. To select the next exit ramp, another random number between 1 and 75 was selected with the restriction that no previously selected numbers could be chosen. Once the exit ramps were determined, the observer location for the actual observation was determined by enumerating all possible combinations of direction of traffic flow and sides of the ramp on which to stand. As in the determination of the observer locations at the roadway intersections, the possibilities were then randomly sampled with equal probability. The alternate exit ramp sites were selected by taking the first interchange encountered after randomly selecting a direction of travel along the freeway from the primary site. If this alternate site was outside the county or if it was already selected as a primary site, then the other direction of travel along the freeway was used.

After all sites and standing locations were randomly selected, all intersection and exit ramp sites were visited by a researcher prior to the beginning of data collection to determine their usability. If an intersection site had no traffic control device on the selected direction of travel, but had traffic control on the intersecting street, the researcher randomly picked a new standing location using a coin flip. If an exit ramp site had no traffic control on the selected direction of travel, the researcher randomly picked a travel direction and lane that had such a device.

The day of week and time of day for site observations were quasi-randomly assigned to sites in such a way that all days of the week and all daylight hours (7:00 am - 6:00 pm) had essentially equal probability of selection. The sites were observed using a clustering procedure. That is, sites that were located spatially adjacent to each other were considered to be a cluster. Within each cluster, a shortest route between all of the sites was decided (essentially a loop) and each site was numbered. An observer watched traffic at all sites in the cluster during a single day. The day in which the cluster was to be observed was randomly determined. After taking into consideration the time required to finish all sites before dark, a random starting time for the day was selected. In addition, a random number between one and the number of sites in the cluster was selected. This number determined the site within the cluster where the first observation would take place. The observer then visited sites following a clockwise or counter-clockwise loop. The direction of the loop was determined by the project manager prior to sending the observers into the field. Because of various scheduling limitations (e.g., observer availability, number of hours worked per week) certain days and/or times were selected that could not be observed. When this occurred, a new day and/or time was randomly selected until a usable one was found. The important issue about the randomization is that the day and time assignments for observations at the sites were not correlated with belt use at a site. This quasi-random method is random with respect to this issue.

The observation interval was a constant duration (50 minutes) for each site. However, since all vehicles passing an observer could not be surveyed, a vehicle count of all eligible vehicles (i.e., passenger cars, vans/minivans, sport-utility vehicles, and pickup trucks) on the traffic leg under observation was conducted for a set duration (5 minutes) immediately prior to and immediately following the observation period (10 minutes total). These counts were used to estimate the number of possible observations so that sites could be weighted by traffic volume.

Descriptive Statistics

Table 2 shows descriptive statistics for the survey. As shown in this table, the observations were fairly well distributed over day of week. Observations were also well distributed by time of day except for the latest time period. Note that an observation session was included in the time slot that represented the majority of the observation period. If the observation period was evenly distributed between two time slots, then it was included in the later time slot. This table also shows that the majority of sites observed were the primary sites and that observations were mostly conducted during sunny or cloudy conditions. A very small number of observations were conducted during rain, and none during snow.

Table 2. Descriptive Statistics for the Survey							
Day of Week		**Observation Period**		**Site Choice**		**Weather**	
Mon	11.3	7-9 a.m.	15.4	Primary	96.2	Sunny	56.7
Tues	19.6	9-11 a.m.	23.6	Alternate	3.8	Cloudy	38.3
Weds	10.8	11-1 p.m.	19.6			Rain	5.0
Thurs	12.1	1-3 p.m.	10.0			Snow	0.0
Friday	21.3	3-5 p.m.	28.3				
Sat	12.5	5-7 p.m.	2.1				
Sun	12.5						
TOTALS	100		100		100		100

Data Collection

Data collection for the survey involved direct observation of shoulder belt use, estimated age, and sex. Trained field staff observed shoulder belt use of drivers and front-right passengers traveling in passenger cars, sport-utility vehicles, vans/minivans, and pickup trucks during daylight hours from August 6, 2004 to August 29, 2004. Observations of safety belt use, sex, age, vehicle type, and vehicle purpose (commercial or noncommercial) were conducted when a vehicle came to a stop at a traffic light or a stop sign. Vehicles were included without regard to the state in which the vehicle was registered.

Data Collection Forms

Data were collected during the mobilization using personal digital assistants (PDAs). For a more detailed description of the PDA data collection process, see Appendix A. Two electronic forms were developed for data collection: a site description form and an observation form. For each site surveyed, separate electronic copies of the site description form and observation form were created in advance. The site description form allowed observers to provide descriptive information including the site location, site type (freeway exit ramp or intersection), site choice (primary or alternate), observer name, date, day of week, time of day, weather, and a count of eligible vehicles traveling on the proper traffic leg. A place on the form was also furnished for observers to electronically sketch the intersection and to identify observation location. Finally, a comments section was available to identify landmarks that might be helpful in characterizing the site (e.g., school, shopping mall) and to discuss problems or issues relevant to the site or study.

A second electronic form, the observation form, was used to record safety belt use, passenger information, and vehicle information. For each vehicle surveyed, shoulder belt use, sex, and estimated age of the driver and the front-outboard passenger were recorded along with vehicle type. Children riding in child restraint devices (CRDs) were recorded but not included in any part of the analysis. Occupants observed with their shoulder belt worn under the arm or behind the back were noted but considered belted in the analysis. The observer also recorded whether the vehicle was commercial or noncommercial. A commercial vehicle is defined as a vehicle that is used for business purposes and may or may not contain company logos. This classification includes vehicles marked with commercial lettering or logos, or vehicles with ladders or other tools on them.

Procedures at Each Site

All sites in the sample were visited by one observer for a period of one hour. Upon arriving at a site, the observer determined whether observations were possible at the site. If observations were not possible (e.g., due to construction), the observer proceeded to the alternate site. Otherwise, the observer completed the site description form and then moved to their observation position near the traffic control device. Observers were instructed to observe only vehicles in the lane immediately adjacent to the curb, regardless of the number of lanes present.

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

Observer Training

Prior to data collection, members of the Minnesota Department of Public Safety, Office of Traffic Safety (OTS) staff were trained on field data collection procedures. The training of OTS staff included both classroom review of data collection procedures and practice field observations. Field observers were then hired and trained by OTS staff on the proper procedures for data collection. Each observer received a training manual containing detailed information on field procedures for observations, data collection forms, and administrative policies and procedures. A site schedule identifying the location, date, time, and traffic leg to be observed for each site was included in the manual (see Appendix B for a listing of the sites). During data collection, observers were spot checked in the field by a field supervisor to ensure adherence to study protocols.

Data Processing and Estimation Procedures

The site description form and observation form data were entered into PDAs directly, so no data entry was required. For each site, computer analysis programs determined the number of observed vehicles, belted and unbelted drivers, and belted and unbelted passengers. Separate counts were made for each independent variable in the survey (i.e., site type, time of day, day of week, weather, sex, age, seating position, and vehicle type). This information was combined with the site information to create a file used for generating study results.

As mentioned earlier, our goal in this safety belt survey was to estimate belt use for the state of Minnesota based on VMT. As also discussed, not all eligible vehicles passing the observer could be included in the survey. To correct for this limitation, the vehicle count information was used to weight the observed traffic volumes so that an estimate of traffic volume at the site could be derived.

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

Estimation of Use Rates

The overall safety belt use rate for Minnesota was calculated utilizing the following procedure. The safety belt use rate for each stratum was calculated using the following formula:

$$R_s = \sum \frac{est_i}{obs_i} belted_i \Big/ \sum \frac{est_i}{obs_i} occs_i$$

Where R_S is the use rate for a stratum, i is a site in the stratum, est_i is the estimated number of possible observations had every eligible vehicle been recorded (based on the vehicle counts), obs_i is the actual number of people observed, $belted_i$ is the number of people observed using a safety belt, and $occs_i$ is the number of occupants.

Because the number of intersections among the first four strata and the number of exit ramps among the last four strata differed, the probability of an intersection or exit ramp being randomly selected differed between strata. Therefore, we painstakingly counted all intersections in the first four strata and all exit ramps in the last four strata and used these counts to weight use rates when combining them. The first four strata (intersections) were combined using the following formula:

$$R_i = \frac{\frac{4N_1}{N_{all}} R_1 + \frac{4N_2}{N_{all}} R_2 + \frac{4N_3}{N_{all}} R_3 + \frac{4N_4}{N_{all}} R_4}{\frac{4N_1}{N_{all}} + \frac{4N_2}{N_{all}} + \frac{4N_3}{N_{all}} + \frac{4N_4}{N_{all}}}$$

$$R_i = \frac{N_1 R_1 + N_2 R_2 + N_3 R_3 + N_4 R_4}{N_1 + N_2 + N_3 + N_4}$$

where R_i is the combined use rate for the first four strata (intersections), N_1 is the total number of intersections in stratum 1 and so on, and N_{all} is the total number of intersections among all four strata. The use rate for the exit ramp strata (strata 5-8) was calculated using the following formula:

$$R_e = \frac{\frac{4N_5}{N_{all}} R_5 + \frac{4N_6}{N_{all}} R_6 + \frac{4N_7}{N_{all}} R_7 + \frac{4N_8}{N_{all}} R_8}{\frac{4N_5}{N_{all}} + \frac{4N_6}{N_{all}} + \frac{4N_7}{N_{all}} + \frac{4N_8}{N_{all}}}$$

$$R_e = \frac{N_5 R_5 + N_6 R_6 + N_7 R_7 + N_8 R_8}{N_5 + N_6 + N_7 + N_8}$$

where R_e is the combined use rate for strata 5-8 (exit ramps), N_5 is the total number of exit ramps in stratum 5 and so on, and N_{all} is the total number of exit ramps among all four strata.

Because only statewide VMT for limited access roadways was available and because only 29 percent of Minnesota travel is on limited access roadways, the statewide safety belt rate was determined weighting R_e and R_i by their VMT using the following equation:

$$R_{MN} = \frac{VMT_i R_i + VMT_e R_e}{VMT_i + VMT_e}$$

Estimation of Variance

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

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

where *var(r$_i$)* equals the variance within a stratum, n is the number of observed intersections, g_i is the weighted number of vehicle occupants at intersection *I*, g_k is the total weighted number of occupants at all sites within the stratum, r_i is the weighted belt use rate at intersection *I*, r is the stratum belt use rate, N is the total number of intersections within a stratum, and $s_i = r_i(1-r_i)$. In the actual calculation of the stratum variances, the second term of this equation was negligible and was dropped in the variance calculations as is common practice.

Again because the number of intersections and exit ramps differed among the strata, when the variances were combined, they were weighted by the number of intersection/exit ramps within each strata. The variances for the first four (intersection) strata were combined using the following formula:

$$\mathrm{var}(Ri) = \left(\frac{N_1}{N_{all}} \right)^2 \mathrm{var}(R_1) + \left(\frac{N_2}{N_{all}} \right)^2 \mathrm{var}(R_2) + \left(\frac{N_3}{N_{all}} \right)^2 \mathrm{var}(R_3) + \left(\frac{N_4}{N_{all}} \right)^2 \mathrm{var}(R_4)$$

The variance for the exit ramp strata were combined using the following formula:

$$\mathrm{var}(\mathrm{Re}) = \left(\frac{N_5}{N_{all}}\right)^2 \mathrm{var}(R_5) + \left(\frac{N_6}{N_{all}}\right)^2 \mathrm{var}(R_6) + \left(\frac{N_7}{N_{all}}\right)^2 \mathrm{var}(R_7) + \left(\frac{N_8}{N_{all}}\right)^2 \mathrm{var}(R_8)$$

The overall variance was determined by weighting the intersection and exit ramp variances relative to the statewide VMT for these types of roadways using the following equation:

$$\mathrm{var}(R) = \frac{(VMT_i)^2 \mathrm{var}(R_i) + (VMT_e)^2 \mathrm{var}(R_e)}{(VMT_i + VMT_e)^2}$$

The 95 percent confidence band was calculated using the formula:

$$95\% ConfidenceBand = R \pm 1.96\sqrt{\mathrm{var}(R)}$$

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

$$\mathrm{Re}\,lativeError = \frac{SE}{R}$$

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

RESULTS

The survey estimated statewide safety belt use for four vehicle types combined (passenger cars, vans/minivans, sport-utility vehicles, and pickup trucks), in addition to reporting use rates for occupants in each vehicle type separately. Following NHTSA (1998) guidelines, this survey included both commercial and noncommercial vehicles.

Overall Safety Belt Use

Table 3 shows the estimated safety belt use rate in Minnesota for all front-outboard occupants traveling in either passenger cars, sport-utility vehicles, vans/minivans, or pickup trucks in the front-outboard positions in Minnesota during the survey period. The "±" value following the use rate indicates a 95 percent confidence band around the percentage. As shown in this table, the statewide safety belt use rate during August 2004 was 82.1 ± 1.8 percent. When compared with the rate found in Minnesota's last full statewide survey conducted in June 2004 of 78.6 ± 2.2 percent, the present rate shows that safety belt use has significantly increased in Minnesota over the last 6 months. The relative error of 1.1 percent for the statewide safety belt use rate was well below the 5 percent maximum required by NHTSA.

Table 3 also shows the use rates for roadway types by stratum and overall. There was no obvious pattern of use by roadway type when compared among stratum. Overall, however, use at exit ramps was slightly higher. When averaged over the exit ramps and intersections, safety belt use was highest for strata in Hennepin County (Strata 2 and 6). Use rates for low, medium, and high belt use areas of the sample were very similar.

Table 3: Safety Belt Use Rates and Unweighted Ns as a Function of Survey, Stratum, Roadway Type, and Overall Statewide Safety Belt Use

	Percent Use	**Unweighted N**
Stratum 1 (High, Intersections)	82.2	1,634
Stratum 2 (Hennepin, Intersections)	83.1	3,717
Stratum 3 (Medium, Intersections)	83.4	1,609
Stratum 4 (Low, Intersections)	79.2	1,663
Stratum 5 (High, Exit Ramps)	82.2	2,093
Stratum 6 (Hennepin, Exit Ramps)	87.4	2,722
Stratum 7 (Medium, Exit Ramps)	79.9	2,064
Stratum 8 (Low, Exit Ramps)	82.7	1,402
Minnesota, Intersections	81.4	8,623
Minnesota, Exit Ramps	83.6	8,281
STATE OF MINNESOTA	**82.1 ± 1.8%**	**16,904**

Safety Belt Use by Subcategory

Vehicle Type and Stratum. Estimated belt use rates and unweighted numbers of occupants by stratum and vehicle type are shown in Tables 4a through 4d. Within each vehicle type we find little systematic differences in safety belt use by stratum. However, comparing across vehicle types and strata, we find that safety belt use is lower for pickup truck occupants in all cases. Thus, enforcement and public information and education (PI&E) programs should target pickup truck occupant.

Table 4a. Percent Shoulder Belt Use by Stratum (Passenger Cars)		
	Percent Use	Unweighted N
Stratum 1	83.3	749
Stratum 2	86.2	1,964
Stratum 3	83.8	735
Stratum 4	79.2	713
Stratum 5	84.6	1,183
Stratum 6	87.9	1,490
Stratum 7	82.6	986
Stratum 8	84.6	669
STATE OF MINNESOTA	**82.9 ± 2.1 %**	8,489

Table 4b. Percent Shoulder Belt Use by Stratum (Sport-Utility Vehicles)		
	Percent Use	Unweighted N
Stratum 1	89.8	304
Stratum 2	83.6	695
Stratum 3	87.4	278
Stratum 4	87.9	237
Stratum 5	81.7	312
Stratum 6	92.0	576
Stratum 7	83.3	310
Stratum 8	87.2	237
STATE OF MINNESOTA	**87.3 ± 2.1 %**	2,949

Table 4c. Percent Shoulder Belt Use by Stratum (Vans/Minivans)		
	Percent Use	Unweighted N
Stratum 1	87.9	259
Stratum 2	85.5	543
Stratum 3	88.1	213
Stratum 4	84.6	262
Stratum 5	86.4	333
Stratum 6	90.5	362
Stratum 7	82.0	328
Stratum 8	91.2	217
STATE OF MINNESOTA	**86.9 ± 3.5 %**	2,517

Table 4d. Percent Shoulder Belt Use by Stratum (Pickup Trucks)		
	Percent Use	Unweighted N
Stratum 1	68.1	322
Stratum 2	66.3	515
Stratum 3	74.6	383
Stratum 4	70.0	451
Stratum 5	66.3	265
Stratum 6	72.0	294
Stratum 7	69.7	440
Stratum 8	68.9	279
STATE OF MINNESOTA	**70.7 ± 2.6 %**	2,949

Time of Day. Estimated safety belt use by time of day, vehicle type, and all vehicles combined is shown in Table 5. Note that these data were collected only during daylight hours. For all vehicles combined and for each vehicle type, safety belt use was generally highest during the non-commuting hours. This finding is consistent with previous research in Minnesota (Eby, Vivoda, & Cavanagh, 2003). This result may indicate that vehicle occupants may have the belief that they are more likely to be ticketed for nonuse of safety belts during non-commuting hours. If so, this result suggests that Minnesota should shift safety belt enforcement efforts to concentrate on commuting hours, when a majority of vehicles are on the road.

Day of Week. Estimated safety belt use by day of week, vehicle type, and all vehicles combined is shown in Table 5. Note that the survey was conducted over a 3-week period. Belt use clearly varied from day to day, but few systematic differences were evident. It appears that belt use may have been lower during the weekend, when compared to weekdays for most vehicle types.

Weather. Estimated belt use by prevailing weather conditions, vehicle type, and all vehicles combined is shown in Table 5. Very few sites were conducted during rainy weather conditions. There was essentially no difference in belt use whether it was sunny or cloudy during data collection; a common finding in safety belt research.

Sex. Estimated safety belt use by occupant sex, type of vehicle, and all vehicles combined is shown in Table 5. Estimated safety belt use is higher for females than for males for all vehicle types combined and for each separate vehicle type. The greatest difference between sexes (14.8 percentage points) was found for pickup truck occupants.

Age. Estimated safety belt use by age, vehicle type, and all vehicle types combined is shown in Table 5. As there were very few 0-to-10 year olds observed in the current study, the estimated safety belt use rate for this age group is not meaningful. Excluding this group, we found that belt use was generally high for the 11-to-15-year olds. Belt use rates for the 16-to-29-year-old age group were consistently the lowest, while rates for the 30-to-64-year-old age group are consistently below those of occupants older than 64 years of age, except for pickup truck occupants. This pattern shows that new drivers and young drivers (16-to-29 years of age) should be a focus of safety belt use messages and programs.

Seating Position. Estimated safety belt use by position in vehicle, vehicle type, and all vehicles combined is shown in Table 5. This table shows that for all vehicle types combined, belt use was slightly higher for drivers. However, when seating position is examined in each vehicle type separately, we find that belt use is higher for the driver than the passenger in all vehicles except vans/minivans, where belt use was nearly five percentage points lower for the driver. Such a finding is unusual in safety belt use research and will be monitored in future surveys.

Age and Sex. Table 6 shows estimated safety belt use rates and unweighted numbers (N) of occupants for all vehicle types combined by age *and* sex. The belt use rates for the two youngest age groups should be interpreted with caution because the unweighted number of occupants is low. Belt use for females in all age groups was higher than for males. However, the absolute difference in belt use rates between sexes varied depending upon the age group. The most notable difference is found in the 16-to-29-year-old age group, where the estimated belt use rate is 12.6 percentage points higher for females than for males. These results argue strongly for statewide efforts to be directed toward persuading young males, and males in general, to wear their safety belts.

Table 5. Percent Shoulder Belt Use and Unweighted N by Vehicle Type and Subgroup (Full Survey)

	All Vehicles		Car		SUV		Van/Minivan		Pickup Truck	
	Percent Use	N	Percent Use	N	Percent Use	N	Percent Use	N	Percent Use	N
Overall	82.1	16,904	82.9	8,489	87.3	2,949	86.9	2,517	70.7	2,949
Site Type										
Intersection	81.4	8,623	81.9	4,161	87.6	1,514	86.4	1,277	71.3	1,671
Exit Ramp	83.6	8,281	85.3	4,328	86.6	1,435	88.0	1240	69.4	1,278
Time of Day										
7 - 9 a.m.	85.7	2,423	90.2	1,226	80.2	420	78.9	368	76.4	409
9 - 11 a.m.	77.6	2,527	77.4	1,266	79.2	432	81.1	379	68.6	450
11 - 1 p.m.	83.6	4,101	83.7	2,004	86.8	740	88.3	611	76.5	746
1 - 3 p.m.	81.4	3,925	83.1	1,978	84.5	703	90.9	552	68.2	692
3 - 5 p.m.	82.1	3,233	82.8	1,669	87.5	529	87.7	513	71.8	522
5 - 7 p.m.	88.1	695	92.6	346	86.4	125	86.9	94	83.3	130
Day of Week										
Monday	83.6	1,559	83.0	713	88.5	260	89.1	236	76.7	350
Tuesday	78.9	2,509	82.0	1,191	84.3	400	82.5	358	66.3	560
Wednesday	76.1	1,645	79.5	807	80.7	241	77.5	281	64.4	316
Thursday	78.3	2,844	72.6	1,529	91.0	529	84.3	378	69.7	408
Friday	83.0	4,948	82.8	2,556	86.2	857	90.0	769	73.4	766
Saturday	83.4	2,536	84.2	1,338	77.7	504	89.2	381	72.9	313
Sunday	81.7	863	85.0	415	87.1	158	77.0	114	74.1	236
Weather										
Sunny	81.1	10,224	83.3	5,210	83.7	1,818	86.4	1,511	70.4	1,685
Cloudy	82.3	5,784	83.9	2,843	88.5	961	86.9	852	69.1	1,128
Rainy	74.0	896	70.0	436	71.1	170	79.3	154	72.5	136
Sex										
Male	77.5	9,308	80.5	4,083	82.4	1,479	82.7	1,293	67.9	2,453
Female	87.6	7,587	85.2	4,404	92.5	1,468	90.6	1,224	82.7	491
Age										
0 - 10	88.0	168	75.7	62	90.3	31	95.4	28	86.6	47
11 - 15	85.8	315	81.0	123	90.5	65	81.9	90	87.4	37
16 - 29	76.2	4,701	78.6	2,720	82.5	706	84.4	407	58.9	868
30 - 64	84.3	10,198	84.3	4,607	89.9	2,001	86.8	1,769	75.7	1,821
65 - Up	85.4	1,516	87.8	974	87.6	145	89.0	223	68.1	174
Position										
Driver	82.1	13,256	83.7	3,276	87.9	1,180	85.0	946	70.8	1,298
Passenger	81.5	3,648	80.4	885	85.8	334	90.6	331	69.5	373

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

Age Group	Male		Female	
	Percent Use	Unweighted N	Percent Use	Unweighted N
0 - 10	84.5	97	92.0	69
11 - 15	79.3	143	92.3	172
16 - 29	70.4	2,517	83.0	2,181
30 – 64	80.4	5,757	89.4	4,437
65 - Up	80.9	790	90.2	726

DISCUSSION

The main purpose for conducting this survey was to continue monitoring the progress of Minnesota's efforts to increase safety belt use statewide. Our analyses showed that the efforts over the last 6 months have been successful in significantly increasing Minnesota belt use by several percentage points. The estimated statewide safety belt use rate for front-outboard occupants of passenger cars, sport-utility vehicles, vans/minivans, and pickup trucks combined was 82.1 ± 1.8 percent. This rate is slightly higher than the national average of 80 percent estimated from the National Occupant Protection Use Survey (NOPUS) conducted by NHTSA (Glassbrenner, 2004). The results from the previous survey conducted in June 2004 (Eby, Vivoda, & Cavanaugh, 2004) showed that Minnesota was about the same as the national average. Thus, Minnesota safety belt use has risen faster than the nation's belt use in general.

Analysis of safety belt use by the various subgroups showed that there are several areas on which Minnesota should continue to focus efforts to increase safety belt use. The lowest use group discovered was young people. While this group is commonly found to have lower safety belt use than other groups, it is also the group in which the biggest gains in traffic-crash-related-injury reduction can be found. On a per population basis, young drivers in the US had the highest rate of involvement in fatal crashes of any age group in 2001 and their fatality rate based on vehicle miles traveled was four times greater than the comparable rate for drivers age 26 to 65 (NHTSA, 2002). Teenage drivers have by far the highest fatal crash involvement rate of any age group based on number of licensed drivers. Motor vehicle injury rates also show that teenagers continue to have vastly higher rates than the population in general.

Given these high crash rates, why do younger drivers fail to buckle-up? One reason is their perceptions of risk. Our thoughts about risks and how we assess them have been termed risk perception (see e.g., DeJoy, 1989a, 1990a; Fischhoff, Lichtenstein, Slovic, Derby, & Keeney, 1981). Because risky driving behaviors are both a public health issue (they increase the risk of injury) and a legal issue (they are illegal), these two types of perceived risk are relevant for traffic safety. For each type of risk, there are two perceived probabilities that are important: the probability of the negative event occurring and the severity of the negative outcome. In the public health domain the negative event is a crash and the severity of the outcome is the extent of injury. In the legal domain, the negative event is getting pulled over by police and receiving a citation for safety belt nonuse and the severity of outcome is the costs associated with the citation (fines, increased insurance premiums, etc.). Both components interact to influence behavior. For example, if the perceived severity of the outcome is quite small (low fines), then a high perceived chance of receiving a citation will not change behavior. Conversely, it a person thinks the event will never happen (i.e., the person believes that they will never crash), then a high perceived severity of the outcome will not influence behavior.

A number of studies have investigated perceptions of traffic crash and injury risk by age and the majority have found that young drivers tend to perceive less risk in specific crash scenarios and general driving than do older drivers (e.g., Finn & Bragg, 1986; Groeger & Chapman, 1996; Sivak, Soler, Tränkle, & Spagnhol, 1989; Tränkle, Gelau, & Metker, 1990). Young drivers also tend to see themselves as less likely to be in a crash than others in their own age group (e.g., DeJoy, 1989a, 1990a; Finn & Bragg, 1986; Matthews & Moran, 1986; Svenson, 1981; Svenson, Fischhoff, & MacGregor, 1985). Work has also shown that young people tend to perceive less risk of a crash when they are driving than when they are passengers, a result not found with older people (Bragg & Finn, 1985; Greening & Chandler, 1997; McKenna, 1993). Thus, developing program designed to change the risk perception (both the perceived likelihood and perceived severity) of safety belt nonuse might be effective for changing the behavior of young drivers.

Occupants of pickup trucks also define a unique population that exhibits low safety belt use in Minnesota, and may therefore benefit from specially designed programs. Research has shown that the main demographic differences between the driver/owners of pickup trucks and passenger cars is that driver/owners of pickup trucks are more likely to be male, have higher household incomes, and lower educational levels (Anderson, Winn, & Agran, 1999). Recent focus group work by the Center for Applied Research (NHTSA, 2004) with rural pickup truck drivers explored why these occupants wear, or do not wear, safety belts. The following reasons were given for nonuse of safety belts: vehicle size protects them from serious injury; safety belt not needed for short or work trips; fear of being trapped in vehicle after a crash; inconsistency between belt law and motorcycle helmet law; and opposition to government mandate. Reasons given for use were: presence of family or friends; travel on interstate highways, travel during inclement weather; and when not traveling in their pickup truck. This information provides a starting point for the development of programs designed to influence pickup truck occupant safety belt use, as efforts to encourage belt use by occupants of pickup trucks are warranted. The Center for Applied Research (NHTSA, 2004) study also suggests passage of mandatory motorcycle helmet use law might also increase belt use among pickup truck drivers.

We discovered large differences in safety belt use between males and females. Understanding why there is a difference in belt use between males and females is very important. In the current survey there is a belt use difference of 10 percentage points between the sexes. According to the Motor Vehicle Occupant Safety Survey, when safety belt non-users and part-time users were asked why they did not wear belts, males and females give different reasons (Block, 2000). Females state "I forgot to put it on" as the most important reason for non-use, while males list "I'm only driving a short distance" as the reason most important to them. An analysis of the types of answers given for non-use by sex revealed that males tend to report reasons that are related to a lower perception of risk (e.g. low probability of a crash or receiving a citation), while more of the answers given by female non-users and part-time users are related to discomfort and forgetting. Traffic safety professionals in Minnesota could use this information for the development of programs aimed at increasing belt use among males.

Belt use was slightly higher for exit ramps than for intersections. As discussed by Slovic (1984; see also Eby & Molnar, 1999), this finding may show that people judge whether to use a safety belt on a trip-by-trip basis and erroneously consider travel on limited-access roadways as less safe than travel on other roadways. Such erroneous reasoning could be addressed in PI&E programs.

While the survey found that nearly 82 percent of Minnesota motor vehicle occupants are using safety belts, NHTSA (1997) has set a goal of 90 percent belt use nationwide. In order to increase belt use to this rate, Minnesota needs to redouble its efforts. The single most effective effort to increase safety belt use statewide would be to change the enforcement provision of Minnesota's safety belt law from secondary to primary enforcement. As discussed in a recent article (Eby, Vivoda, & Fordyce, 2002), nine of the first ten states to make such a change found 8-22 percentage point increases with primary enforcement.

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APPENDIX A:
PDA Data Collection Details

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

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

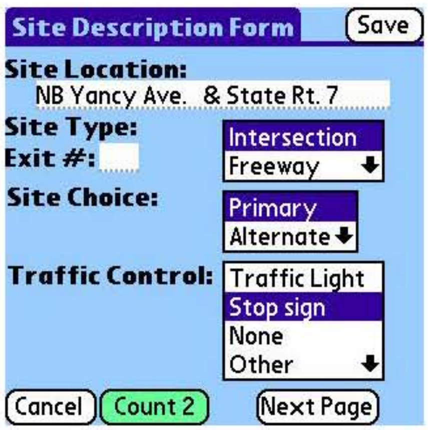

Figure 2. Site Description Form - Screen 1

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

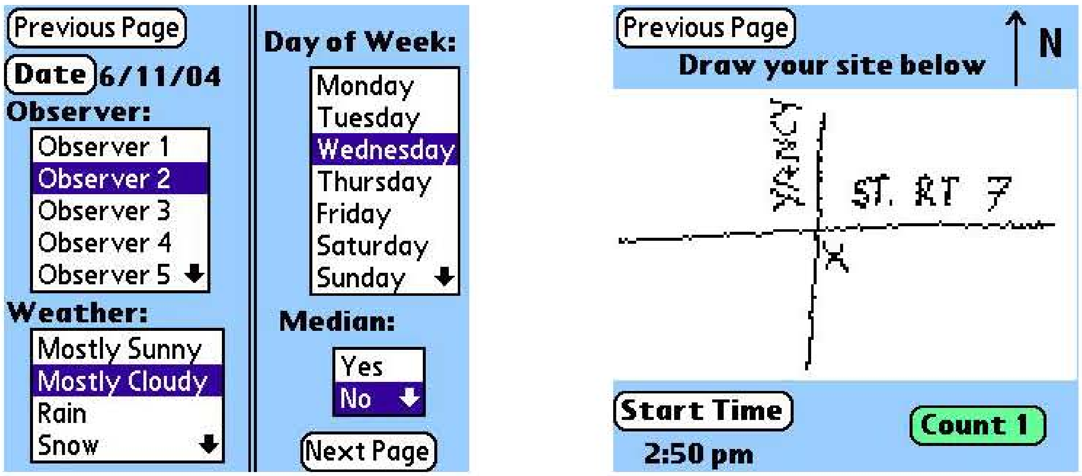

Figure 3. Site Description Form - Screens 2 and 3

In the past, observers had to put away their paper form, get out a mechanical traffic counter, and begin a traffic count after entering the start time. Using a PDA, it is possible to incorporate a traffic counter directly into the *Site Description Form*[1]. Figure 4 shows an example of the electronic traffic counter screen of the *Site Description Form*. To count each vehicle that passes, observers tap on the large "+" button. The size of this button allows the observer to tap the screen while keeping their eyes on the roadway. Each tap increases the count that is displayed at the top of the screen. If a mistake is made, the observer can decrease the count by tapping on the small "-" button on the left of the screen.

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

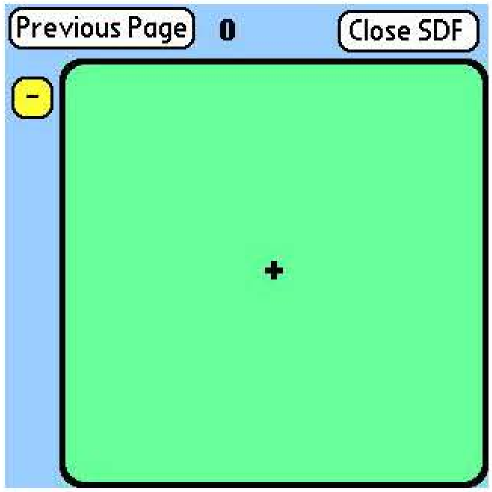

Figure 4. Site Description Form - Traffic Counter Screen

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

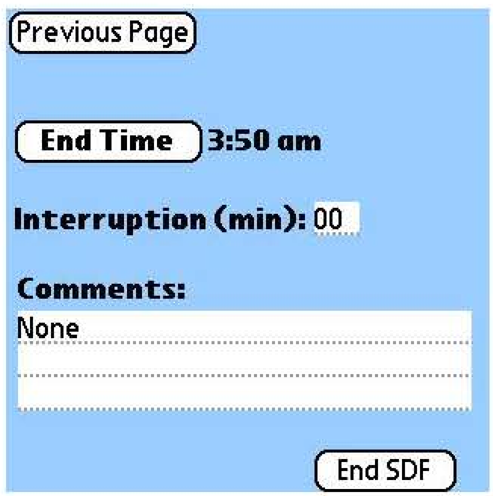

Figure 5. Site Description Form - Final Screen

To allow for easier data entry, the electronic *Observation Form* was divided into three screens, one for driver information, one for front-right passenger information, and one for vehicle information. As shown in Figure 6, each screen is accessible by tapping on the appropriate tab along the top of the screen. The screens have also been designed with different colors, with the driver screen blue, passenger screen green, and vehicle screen yellow. As shown below, the first screen that appears in the form is the driver screen. Each category of data, along with the choices for each category, are displayed on the screen. As in the Site Description Form, users simply tap on the choices that correspond to the motorist that is being observed. These data then appear highlighted on the screen. Since most motorists are not actively using a cellular phone while driving, “No Cell Phone” is already highlighted as a default. If the motorist is using a cell phone, the proper choice can simply be selected from the list.

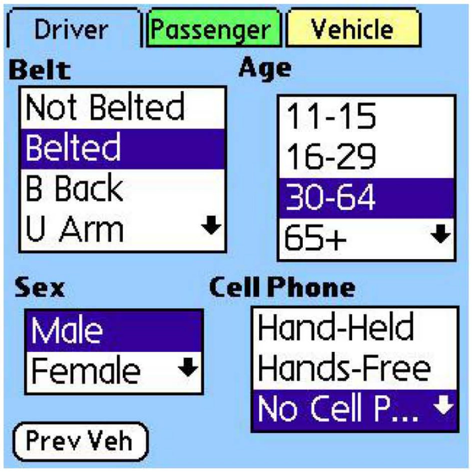

Figure 6. Observation Form - Driver Screen

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

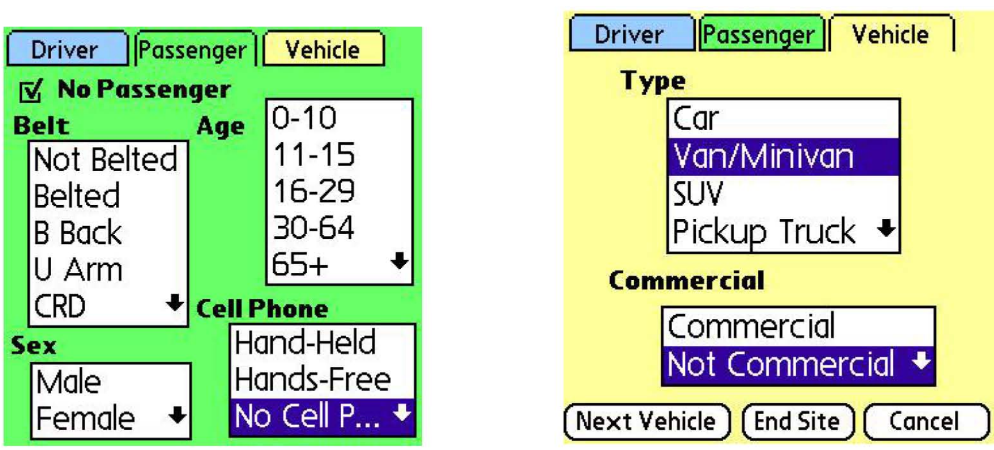

Figure 7. Observation Form - Passenger and Vehicle Screens

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

APPENDIX B:
Site Listing

Survey Sites By Number

No.	County	Site Location
001	Dakota	EB 135th St/Co. Rd. 38 & Blaine Ave/County Rout 71/Rich Valley Blvd
002	Olmsted	EB CR 112/County Route 12 & CR 112
003	Carver	EB 150th St/County Route 50 & County Route 41
004	Carver	EB 70th St/County Route 30 & State Route 25/Ash
005	Carver	NB Yancy Ave & State Route 7
006	Carver	SB Little Ave & 102nd St
007	Dakota	EB W 136th St & Nicollet Ave
008	Wright	WB CR 123 & County Route 7/CR 106
009	Olmsted	EB CR 120 & County Route 20
010	Wright	EB CR 118/CR18/50th St. & County Route 35/Main St.
011	Dakota	NB CR 21/Guam Ave & 307th St/CR 90
012	Wright	EB 14th St/CR 112 & State Route 25
013	Dakota	EB 240th St West & Cedar Ave/County Route 23
014	Dakota	NB Johnny Cake Ridge Rd & Coutny Route 32/Cliff Rd
015	Olmsted	SB County Route 3 & County Route 4
016	Olmsted	EB CR 137 & CR 136
017	Dakota	EB 80th St & Concord Blvd/County Route 56
018	Dakota	EB 220th St East & Nicolai/County Route 91
019	Dakota	SB Fairgreen Ave & 280th St West/County Route 86
020	Wright	NB County Route 12 & County Route 37
021	Olmsted	WB County Route 9 & County Route 10
022	Dakota	EB Wescott Rd & Lexington Ave
023	Dakota	NB Hogan Ave/County Route 85 & 220th St East
024	Wright	SB US 12/County Route 16 & Babcock Blvd/County Route 30
025	Wright	EB County Route 38/Harrison St. (Near Oak St/CR 24) & State Route 55/State Route 24
026	Dakota	NB Blaine Ave/CR 79 & 245th St East/County Route 80
027	Olmsted	SB CR 119 & County Route 9
028	Dakota	EB County Route 88/290th Street East & Northfield Blvd/County Route 47
029	Ramsey	NB Hodgson Rd/County Route 49 & Turtle/County Route 3/CR 1
030	Carver	SB Yale Ave/Yancy Ave & County Route 30
031	Olmsted	NB CR 125/Maywood Rd. SW & County Route 25/Salem Rd. SW
032	Olmsted	EB CR 154/85th St. NW & US 52
033	Wright	SB County Route 12 & State Route 55
034	Carver	WB 62nd St & County Route 33
035	Ramsey	EB Minnehaha Ave/State Route 5 & White Bear Ave/County Route 65
036	Olmsted	SB CR 128 & State Route 247/County Route 12
037	Dakota	SB CR 51/County Route 80/Biscayne Ave & 280th St West/County Route 86
038	Olmsted	NB CR 132/County Route 32 & County Route 9
039	Dakota	SB Inga Ave & State Route 50/240th St East
040	Dakota	EB County Route 14/Grand Ave. & Concord St/State Route 156
041	Dakota	NB Goodwin Ave & State Route 55
042	Ramsey	NB Rice St & Maryland Ave
043	Dakota	SB Emery Ave & 190th St East/County Route 62
044	Ramsey	NBP I-35 W & Old Hwy 8/Anoka Cutoff (Exit 26)
045	Ramsey	NBD I-35 E & County Route 23 (Exit 112)
046	Olmsted	WBP I-90 & County Route 10 (Exit 229)
047	Dakota	SBD I-35 & County Route 50/County Route 5(Exit 85)
048	Ramsey	WBP State Route 36 & Hamline Ave
049	Dakota	SBD US-52 & Thompson Ave
050	Ramsey	SBD I-35 E & St. Clair
051	Dakota	WBD I-494 & Robert St (Exit 67)
052	Dakota	NBD I-35 E & State Route 110/Mendota Rd (Exit 101)
053	Olmsted	EBD I-90 & State Route 42 (Exit 224)
054	Ramsey	SBD I-35 E & Randolph Ave
055	Ramsey	EBD State Route 36 & Lexington Ave/County Route 51
056	Ramsey	EBD US-12/US-52/I-94 & S. Cretin Ave
057	Ramsey	NBP County Route 280 & Energy Park Dr
058	Dakota	SBD US-52/Lafayette Frwy & Butler Ave
059	Ramsey	EBP I-694 & US-61/Maplewood Dr (Exit 48)
060	Ramsey	EBD US-12/US-52/I-94 & Lexington Parkway/County Route 51
061	Hennepin	SB Pineview Ave & 129th Ave

062	Hennepin	WB Olson Memorial Hwy/State Rotue 55 & County Route 102/Douglas Drive
063	Hennepin	NB Mohawk Dr & Horseshoe Tr
064	Hennepin	SB County Route 60/Mitchell Rd & State Route 5
065	Hennepin	WB Gleason Lake Rd/County Route 15 & Vicksburg Lane
066	Hennepin	NEB State Route 7 & Chanhassen Rd/State Route 101
067	Hennepin	NB Brown Rd/County Route 146 & Watertown Rd
068	Hennepin	NB Commerce Blvd & West Branch Rd/County Route 151
069	Hennepin	NB Chanhassen Rd/State Route 101 & Minnetonka Blvd/County Route 5
070	Hennepin	SB County Route 44 & Bartlett Blvd/County Route 110
071	Hennepin	SB Tucker Rd & County Route 116/CR 159/Territorial Rd.
072	Hennepin	NEB Old Shakopee Rd/County Route 1 & Penn Ave.
073	Hennepin	NWB County Route 81 & 77th Ave North/County Route 152/Brooklyn Blvd.
074	Hennepin	NB Belchtold Rd & 109th Ave North/County Route 117
075	Hennepin	NB County Route 34/Normandale Blvd & Old Shakopee Rd/County Route 1
076	Hennepin	NB Penn Ave/County Route 2 & Olson Memorial Highway/State Route 55
077	Hennepin	WB Elm Creek Rd & Fernbrooke Ave/County Route 121
078	Hennepin	NB Pioneer Tr/County Route 113 & Woodland Tr/County Route 10
079	Hennepin	WB Rockford Rd/County Route 9 & Medicine Lake Dr/Larch Lane
080	Hennepin	SB Lyndale Ave & West 50th St/County Route 21
081	Hennepin	NB Willow Dr & County Route 24
082	Hennepin	WB 125th Ave North & Zanzibar Lane
083	Hennepin	SB Lyndale Ave & West 82nd St
084	Hennepin	NB Broadway Ave/CR 103/County Route 130 & 85th Ave North/County Route 109
085	Hennepin	NB Mendelssohn Ave & 63rd Ave
086	Hennepin	WB N 121st Ave & Fernbrooke/County Route 121
087	Hennepin	WB Cedar Lake Rd/County Route 16 & Plymouth Rd/County Route 61
088	Hennepin	EB Nike Rd & Main Street/Country Route 92
089	Hennepin	NWB N Nobel Ave & 109th Ave
090	Hennepin	SB Mohawk Dr & State Route 55
091	Hennepin	NB County Route 32 & West 82nd Street
092	Hennepin	WB County Route 109/85th Ave N & Country Route 158/Rice Lake Rd.
093	Hennepin	SB Country Route 101 & County Route 42/Wayzata Blvd.
094	Hennepin	NB University Ave & County Route 23
095	Hennepin	SB Country Route 116/Fletcher Lane & County Route 30/97th Ave N
096	Hennepin	EB County Route 53/66th St. & State Route 77
097	Hennepin	NB Winnetka Ave/County Route 156 & Medicine Lake Rd
098	Hennepin	SB Goose Lake Rd & Elm Creek Rd
099	Hennepin	WB Medicine Lake Rd/26th St. & Medicine Lake Blvd
100	Hennepin	NB Budd Ave & Pagenkoph Rd
101	Hennepin	EB Duck Lake Tr & Eden Prarie Rd/County Route 4
102	Hennepin	NB Eden Prarie Rd/County Route 4 & Excelsior Blvd/County Route 3
103	Hennepin	SEB County Route 152/Osseo Rd. & N. Penn/44th Ave.
104	Hennepin	SBD State Route 77 & County Route 1/Old Shakopee Rd
105	Hennepin	NBD I-35 W & W 82nd St (Exit 8)
106	Hennepin	WBP State Route 62/Crosstown Hwy & Gleason
107	Hennepin	SBD I-494 & County Route 10/Bass Lake Rd (Exit 26)
108	Hennepin	WBP I-94/US-12/US-52 & S 25th Ave.
109	Hennepin	NBP I-35 W & W 35th St/E 35th St
110	Hennepin	WBP I-94/US-52 & County Route 30/Dunkirk Lane (Exit 213)
111	Hennepin	SBD I-35 W & W 66th St/E 66th St
112	Hennepin	NBP US-169 & 36th Ave N
113	Hennepin	EBP I-494 & Townline Rd/US-169
114	Hennepin	N/WBD I-494 & State Route 55/Olson Memorial Hwy
115	Hennepin	WBP State Route 62/Crosstown Hwy & Tracy Ave
116	Hennepin	SBP State Route 100 & Minnetonka Blvd/County Route 5/Vernon
117	Hennepin	SBP State Route 100 & W 50th St/County Route 21/County Route 158
118	Hennepin	EBD State Route 62 & Portland Ave South
119	Hennepin	NBP US-169 & Valley View Rd
120	Hennepin	NBD US-169 & Plymouth Ave/13th Ave N
121	Sherburne	NB County Route 73/127th St./County Route 48 & CR 73/185th Ave.
122	St. Louis	WB State Route 135/County Route 102 & US 53/State Route 169
123	St. Louis	WB CR 791 & County Route 25
124	Rice	SB Culver Ave & 150th Street W/County Route 9
125	Beltrami	SB State Route 72/County Route 36 & County Route 41
126	Washington	NB Manning & 70th St. S

127	Clay	EB State Route 34 & County Route 25
128	Kandiyohi	WB 255th Ave Northeast & County Route 9
129	St. Louis	EB County Route 16/CR 957 & US 53
130	Kandiyohi	EB CR 107/240th Ave. & 40th Street NE
131	Kandiyohi	WB 105 Ave SE & CR 136/165th St SE
132	Blue Earth	WB County Route 29/State Route 30 & State Route 22/State Route 30
133	Freeborn	NB US-69 & County Route 46
134	Clay	EB CR 105 & County Route 13/County Route 73/90th St. N
135	St. Louis	WB State Route 194/Central Entrance & County Route 90/Arlington
136	Steele	SB County Route 3 & State Route 30
137	Blue Earth	WB County Route 13/County Route 38 & US-169
138	Sherburne	SB US 169 & County Route 4
139	Sherburne	EB CR 54/77th St. SE & State Route 25/125th Ave. SE
140	Freeborn	EB CR 115/County Route 23 & County Route 26
141	Blue Earth	WB CR 167 & County Route 39
142	Sherburne	NWB US 10 & County Route 15
143	St. Louis	EB State Route 194 & US 53
144	Freeborn	NB County Route 24/County Route 45/Independence Ave & County Route 31/CR 116/Main St.
145	Goodhue	SB County Route 1 & State Route 60
146	Freeborn	EB County Route 9/CR 78 & US 69
147	Blue Earth	NB County Route 30/CR 107 & County Route 22/CR 108
148	St. Louis	EB County Route 28/Sax Road & County Route 7
149	Nicollet	EB County Route 15/382nd St. & State Route 15
150	Blue Earth	EB Madison Ave/State Route 22 & State Route 22
151	Steele	SB 7th Ave NE & County Route 8/Mineral Springs Rd.
152	Blue Earth	EB County Route 25/CR 138 & County Route 20
153	Blue Earth	NB County Route 14/CR 173 & State Route 83
154	St. Louis	EB County Route 12/Roberg Rd & Lakewood Rd/CR 692
155	Crow Wing	NB County Route 25/CR 144 & State Route 18
156	Kandiyohi	WB 60th Ave SW & County Route 7/135th St.
157	Scott	EB County Route 2/CR 54 & State Route 13/Langford Ave
158	Blue Earth	SB State Route 60 & US 14/State Route 60
159	Goodhue	SB County Route 4 & County Route 10
160	Kandiyohi	SB CR 127/60th St. NE & County Route 26/60th Ave.
161	Clay	EB 90th Ave./County Route 10 & 70th St./County Route 11/State Route 336
162	Nicollet	NB County Route 7/585TH St. & County Route 1/350th St.
163	Scott	EB CR 64/230th St W & State Route 21/Helena Blvd
164	Steele	SBD I-35 & County Route 4 (Exit 32)
165	St. Louis	SBP I-35 & US-53/Piedmont Ave
166	Freeborn	SBP I-35 & County Route 35 (Exit 22)
167	Clay	EBP I-94 & County Route 10 (Exit 15)
168	Washington	N/WBP I-694 & 10th St/County Route 10 (Exit 57)
169	Clay	WBP I-94 & County Route 52 (Exit 2)
170	Rice	SBP I-35 & State Route 60 (Exit 56)
171	Steele	NBD I-35 & County Route 12 (Exit 48)
172	Beltrami	EBP US-2/US-71 & US-71
173	Freeborn	EBD I-90 & State Route 13 (Exit 154)
174	Freeborn	SBD I-35 & State Route 251 (Exit 18)
175	St. Louis	SBP I-35 & S 27th Ave. W (Exit 254)
176	Washington	SBP I-35 & Central Ave. (Exit 252)
177	St. Louis	N/EBD I-35 & 46th Ave
178	Freeborn	NBD I-35 & County Route 46 ? (Exit 11)
179	Washington	NBP US-10/US-61 & 80th St/Grange Blvd
180	St. Louis	N/EBD I-35 & Skyline Pkwy/Boundary Dr. (Exit 249)
181	Morrison	SB CR 264/205th Ave. & County Route 46/183rd St.
182	Douglas	SB County Route 6 & County Route 22
183	McLeod	WB County Route 26/100th St. & State Route 15
184	Morrison	SB County Route 37 & County Route 26/Nature Rd.
185	Polk	NB County Route 63 & US-2
186	Cass	WB County Route 29/CR 107/76th St. & County Route 1
187	Becker	SB Little Toad Lake Rd/County Route 31 & State Route 87
188	Otter Tail	EB County Route 10 & US 59
189	Otter Tail	EB County Route 60/State Route 228 & US 10
190	Cass	WB County Route 34 & State Route 64

191	Brown	EB County Route 22/CR 102 & County Route 13
192	Morrison	SB County Route 6/90th Ave. & County Route 1/State Route 238
193	Mower	WB 115th St. & County Route 14/770th Ave.
194	Stearns	WB CR 146 & State Route 15
195	Cass	EB County Route 43/Twp 4/12th St. & State Route 84/County Route 44
196	Polk	NB County Route 54 & County Route 11
197	Polk	EB CR 213 & CR 213/County Route 48
198	Winona	NEB County Route 44/Huff St. & US 14/US 61
199	Morrison	EB CR 203/County Route 1 & County Route 2
200	Stearns	SB US 71 & State Route 55
201	Douglas	EB State Route 27 & State Route 29
202	Winona	WB County Route 22 extension (unmarked gravel road North of County Route 115) & County Route 37
203	Anoka	SB CR 67 & County Route 22
204	Cass	EB County Route 66/122nd St. & State Route 371
205	Benton	WB County Route 12/Pine Rd. & State Route 25
206	Becker	SB County Route 49/CR 119 & State Route 87
207	Polk	NB County Route 65 & US-75
208	Stearns	WB CR 149 & County Route 48
209	Isanti	SB State Route 47 & County Route 8
210	Otter Tail	EB County Route 6 & County Route 59
211	Stearns	WB Division St/County Route 75 & State Route 15
212	Itasca	EB US 2/4th St. & State Route 38/3rd Ave.
213	McLeod	SB County Route 25/CR 52/5th Ave. S. & US 212
214	Mower	EB County Route 1 & US 218
215	Benton	SB County Route 6 & County Route 4
216	Brown	WB 150th St./CR100 & County Route 2
217	Anoka	SB County Route 5/CR 56 & Northern Blvd/County Route 5
218	Douglas	NB County Route 40 & County Route 82
219	Douglas	WB County Route 10 & County Route 3
220	Winona	NEB County Route 7 & US 14/US 61
221	Stearns	SEB County Route 152 & County Route 10
222	Stearns	WB County Route 75 & County Route 2
223	Isanti	NB County Route 7/CR 57 & State Route 95
224	Carlton	SWBP I-35 & State Route 45 (Exit 239)
225	Anoka	SBP I-35 W & County Route 23/Lake Dr (Exit 36)
226	Stearns	WBD I-94/US-52 & CR 159 (Exit 156)
227	Winona	EBD I-90 & State Route 43 (Exit 249)
228	Stearns	EBP I-94 & State Route 23 (Exit 164)
229	Anoka	EBP US-10 & State Route 65
230	Chisago	SBD I-35 & County Route 10 (Exit152)
231	Mower	WBP I-90 & State Route 56 (Exit 183)
232	Stearns	EBP I-94 & County Route 7 (Exit 171)
233	Winona	WBP I-90 & State Route 76 (Exit 257)
234	Otter Tail	W/NBP I-94 & US-59/County Route 52/County Route 88 (Exit 50)
235	Anoka	WBP US-10/State Route 610 & State Route 47
236	Douglas	EBD I-94 & State Route 79 (Exit 82)
237	Stearns	WBP I-94 & County Route 9 (Exit 153)
238	Stearns	WBD I-94 & County Route 11 (Exit 137)
239	Carlton	EBD I-35 & State Route 61 (Exit 245)
240	Douglas	EBP I-94 & State Route 29 (Exit 103)