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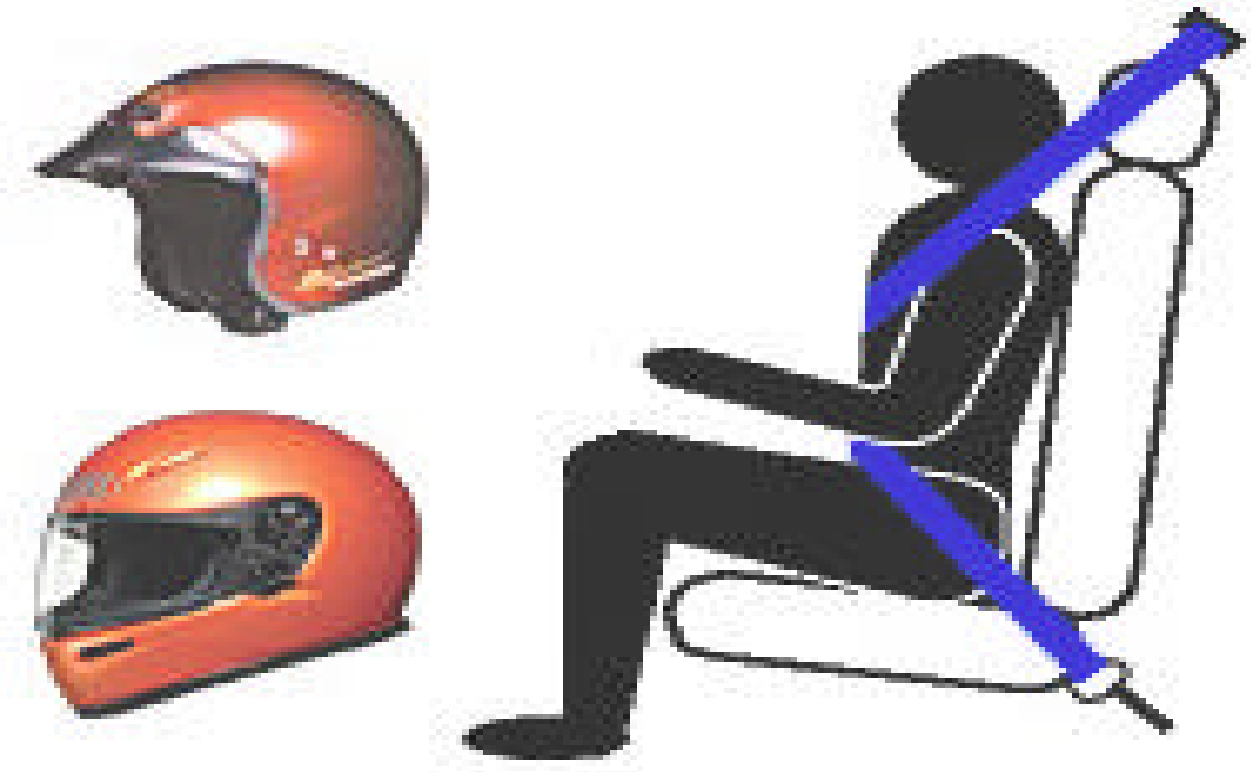
Technical Report

Safety Belt and Helmet Use in 2002 – Overall Results



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16. Abstract

This paper presents the results of the 2002 Moving Traffic Study of the National Occupant Protection Use Survey (NOPUS) and documents the study's sample design, estimation, and data collection procedures.
The main findings on belt and helmet use in 2002 are:

- Belt use reached 75% in 2002.
- Primary states reached a milestone of 80% belt use.
- Belt use increased in the Northeast and in vans and SUVs.
- Helmet use dropped sharply, to 58% from 71% two years ago.

This paper also documents changes to the Moving Traffic Study in 2002. A new data collection protocol was begun for interstates, in which use was observed from moving vehicles on the interstate, rather than from exit ramps. This should eliminate the bias incurred from using the ramps as proxy observation sites. Also, variances of changes from one time period to another were estimated directly in 2002, which should improve assessments of significance. It is planned to apply this variance procedure to all change estimates and significance tests in the near future.

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SUMMARY

Belt use reached 75% nationwide in 2002, which is the highest rate yet observed and continues a relatively steady pattern of increase since use was first measured by a comprehensive national survey at 58 percent in 1994. States that allow more stringent enforcement of their belt use laws ("primary" states) reached a milestone of 80% belt use in 2002, and substantial gains were also seen in the Northeast and in vans and sport utility vehicles (SUVs). On the other hand, motorcycle helmet use declined sharply, to 58% from 71% two years ago. These rates were obtained from the National Occupant Protection Use Survey conducted by the National Highway Traffic Safety Administration (NHTSA) in June 2002.

The two-point increase in belt use in 2002, which is statistically significant with 89% confidence, has substantial effects. An additional six million people buckled up in 2002, saving an estimated 500 lives, on top of the approximately 12,000 that would have been saved at the old rate of 73%. [G] These six million new users comprised 7 percent of the previous nonuser population – that is, 7 percent of those who weren't using belts in 2001 used them in 2002.

The 80% milestone in primary states is a sign of the effectiveness that the mere presence of tough laws can have on use. (See "Primary States Reach 80% Milestone" for descriptions of these laws.) The type of enforcement law has always been a statistically significant factor in belt use, generally making an 11-point difference. It is estimated that if all states had had primary laws in 2002, then an additional 2,000 lives would be saved every year, on top of the 12,000 that would be saved each year with no change in belt laws. [G]

Much of the gain in national use appears to have occurred in the Northeast, and in vans and SUVs nationwide. Although the Northeast remains the region with the lowest belt use, its 7-point gain to 69% makes this region much more comparable to the rest of the country. Approximately one out of every five nonusers in the Northeast in 2001 used belts in 2002, a substantial conversion rate. Vans and SUVs saw a 3-point increase to 78% belt use, which is reassuring in light of recent news on SUV rollover crashes, since belts are particularly effective in such crashes. [D]

The sharp decline in helmet use, which is significant with 95% confidence, is troubling since it comes at a time when motorcyclist fatalities have been increasing. [S3] However, this decline might have been influenced by the June observation, since previously helmet use was observed in the fall months. In addition, the helmet estimates have rather large sampling errors, since only 900 motorcycles were observed. So while one can be 95% confident that use decreased in the past two years, the magnitude of the decline might be substantially smaller than the13 points observed. In addition, it should be kept in mind that this decline occurred over a two-year period (whereas the reference period for belt use is one year ago).

The estimates in this report are obtained from the NOPUS Moving Traffic Study, which provides a quick general picture of belt and helmet use. Greater demographic detail, such as belt use by race/ethnicity and gender, and child seat use are determined from the NOPUS Controlled Intersection Study, results from which will be published later this fall.

This note marks of the beginning of the gradual incorporation of an improved method for observing use on interstates. Unlike other road sites, interstates cannot be observed from the side of the roadway. Previously NOPUS had used exit ramps for proxy observation sites. However, belt use is generally lower on ramps than on interstates because of the greater prevalence of short-trip takers. In addition, the relatively small number of vehicles observed at ramps leads to highly variable use estimates. The estimates in 2002 begin the gradual incorporation of observation from moving vehicles on the interstates, with about 25% of the interstate sites using the new method and 75% using the old. While the new method improves our estimates of use, estimates of increases in use from one year to the next could be slightly exaggerated until the new method is fully incorporated, and so caution should be exercised in investigating changes. For more information, see the section "New Data Collection Protocol on Interstate Roadways".

This note also marks the implementation of a new variance estimation methodology that improves assessments of statistical significance. The data tables include new columns for standard errors of the change estimates, which are used in these assessments. For information on what the methodology is and how to determine significance, see the section "Assessing Statistical Significance".

Section I of this report presents the major findings of the 2002 NOPUS Moving Traffic Survey. Section II contains details on the survey design and data collection procedures. Section III contains more detailed estimates than those in Section I.

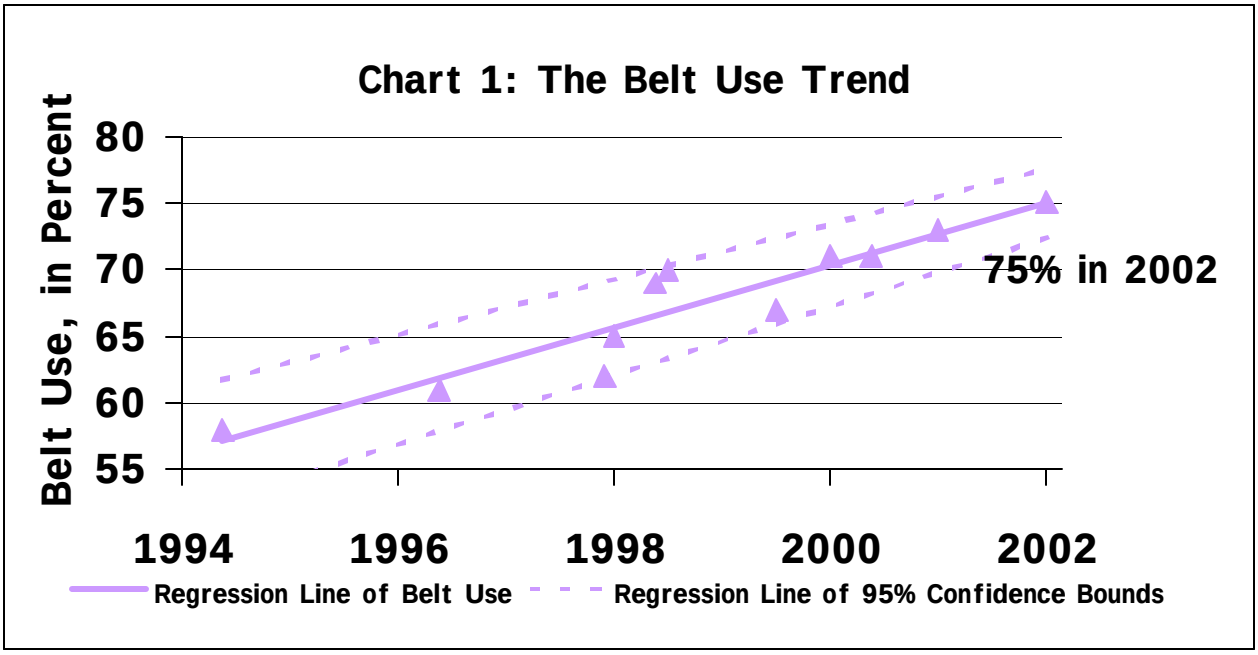
I. Major Findings

The data in this report was collected between June 3, 2002 and June 22, 2002 at about 2,000 observation sites. About 150,000 vehicles, with 50,000 passengers, and 900 motorcycles, with 150 passengers, were observed.

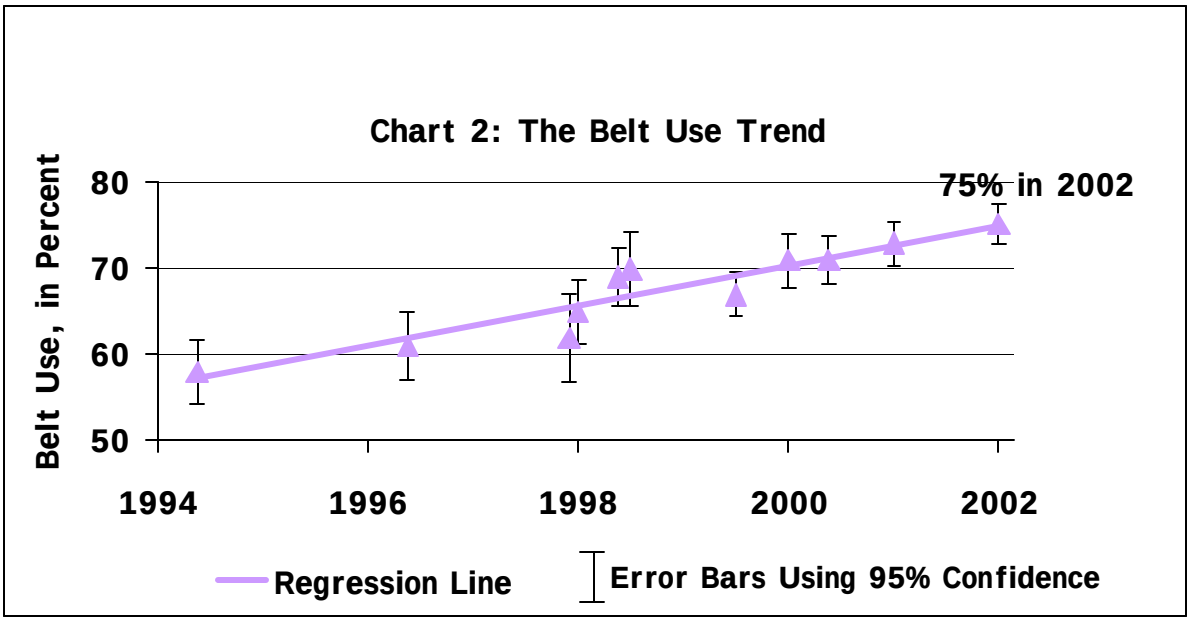
A. Belt Use Reaches 75% Nationwide, Continuing Its Steady Climb.

The national use rate in 2002 is 75%. Although this is not significantly higher than the 2001 rate of 73% according to the 95%-confidence standard, it is higher with 89% confidence. That is, we are 89% confident that belt use increased between 2001 and 2002.

NOPUS indicates that belt use has been increasing about two percentage points per year. Fitting a regression model to the national estimates from NOPUS in 1994-2002, gives that belt use has been increasing by 2.3 percentage points per year. The fairly consistent increases in Chart 1 indicate that our measured increases, which in prior years had not been statistically significant, reflect actual increases. Had NOPUS been a simple random sample, the trend would be significant (i.e. the slope of the regression line is not zero). In the future, we hope to measure the sampling error on the slope using NOPUS's complex design to determine if the belt use trend is statistically significant.



Source: National Center for Statistics and Analysis, NHTSA, National Occupant Protection Use Survey, 1994-2002.



Source: National Center for Statistics and Analysis, NHTSA, National Occupant Protection Use Survey, 1994-2002.

Note that although the sampling error appears to be steadily diminishing in Chart 1, Chart 2 and Table 1 show that sampling error has varied quite a bit. The dashed lines in Chart 1 are the regression lines of the 95% confidence bounds.

Table 1: Belt Use, 1994-2002*

Vehicle and Seat Position	Fall 94	Fall 96	May-98	Jun-98	Fall 98	Dec-98	Dec-99	Jun-00	Fall 00	June 01	June 02
All Vehicles	58 (1.9)	61 (2.0)	62 (2.6)	65 (1.9)	69 (1.7)	70 (2.2)	67 (1.3)	71 (1.6)	71 (1.4)	73 (1.3)	75 (1.2)
Drivers	59 (1.9)	62 (1.8)	63 (2.4)	66 (1.9)	70 (1.8)	70 (2.2)	67 (1.3)	71 (1.6)	72 (1.5)	74 (1.4)	76 (1.2)
Passengers	55 (1.8)	59 (3.3)	60 (3.3)	63 (2.0)	65 (1.9)	69 (2.3)	64 (1.8)	70 (1.6)	68 (1.5)	72 (1.4)	73 (1.4)
Passenger Cars	63 (1.9)	65 (2.1)	66 (2.8)	69 (1.5)	71 (1.7)	72 (2.3)	70 (1.2)	73 (1.5)	74 (1.5)	76 (1.1)	77 (1.1)
Drivers	64 (1.8)	65 (2.1)	67 (2.5)	70 (1.5)	72 (1.9)	73 (2.4)	71 (1.2)	74 (1.5)	75 (1.6)	77 (1.2)	78 (1.1)
Passengers	59 (2.2)	62 (2.3)	62 (3.8)	66 (1.7)	68 (2.0)	72 (2.1)	66 (1.7)	71 (1.7)	70 (1.5)	74 (1.3)	74 (1.4)
Vans, SUVs, and Pickups	50 (1.8)	56 (2.0)	56 (2.4)	60 (2.6)	66 (2.0)	66 (2.4)	62 (1.6)	67 (2.0)	68 (1.7)	69 (1.8)	73 (1.4)
Drivers	51 (1.9)	58 (1.6)	57 (2.6)	61 (2.7)	67 (2.1)	67 (2.4)	62 (1.8)	67 (2.0)	69 (1.9)	70 (1.8)	73 (1.5)
Passengers	49 (1.8)	53 (5.2)	55 (2.7)	58 (2.7)	61 (2.3)	65 (2.8)	60 (2.1)	68 (1.9)	65 (1.4)	69 (1.9)	72 (1.6)

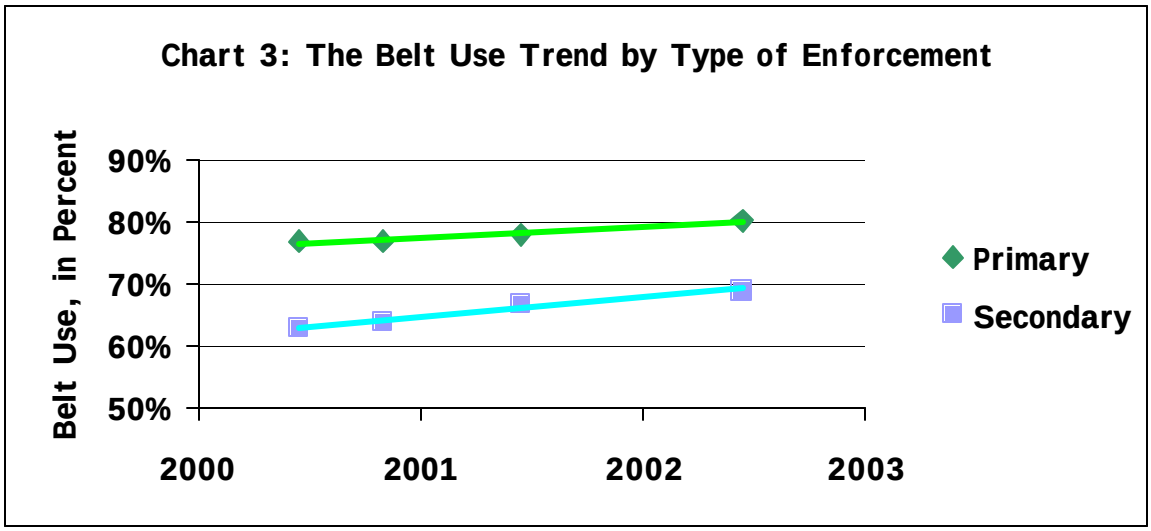
***Standard errors are provided in parentheses following each estimate.**

Source: National Center for Statistics and Analysis, NHTSA, National Occupant Protection Use Survey, 1994-2002.

B. Primary States Reach 80% Milestone.

State seat belt laws vary in terms of the vehicles and seating positions to which they apply and the fines that may be levied. (See [S1] for a complete list of current laws.) Primary enforcement of seat belt laws allows police to stop and cite motorists simply for not wearing seat belts. Under secondary enforcement, motorists must be stopped for another reason in order to receive a seat belt citation.

Primary states reached a milestone of 80% belt use in 2002. Belt enforcement laws continue to be one of the biggest factors affecting belt use, with a statistically significant difference between primary and secondary states seen since NOPUS began. While use is 11 points lower in secondary states, these states have made steady gains in the past few years, converting between 3 and 8 percent of their nonusers to belt users in each of these years. Conversion rates are explained in Section II. F.



Source: National Center for Statistics and Analysis, NHTSA, National Occupant Protection Use Survey, 2000-2002.

Table 2: Belt Use by Type of Enforcement Law, 2000-2002

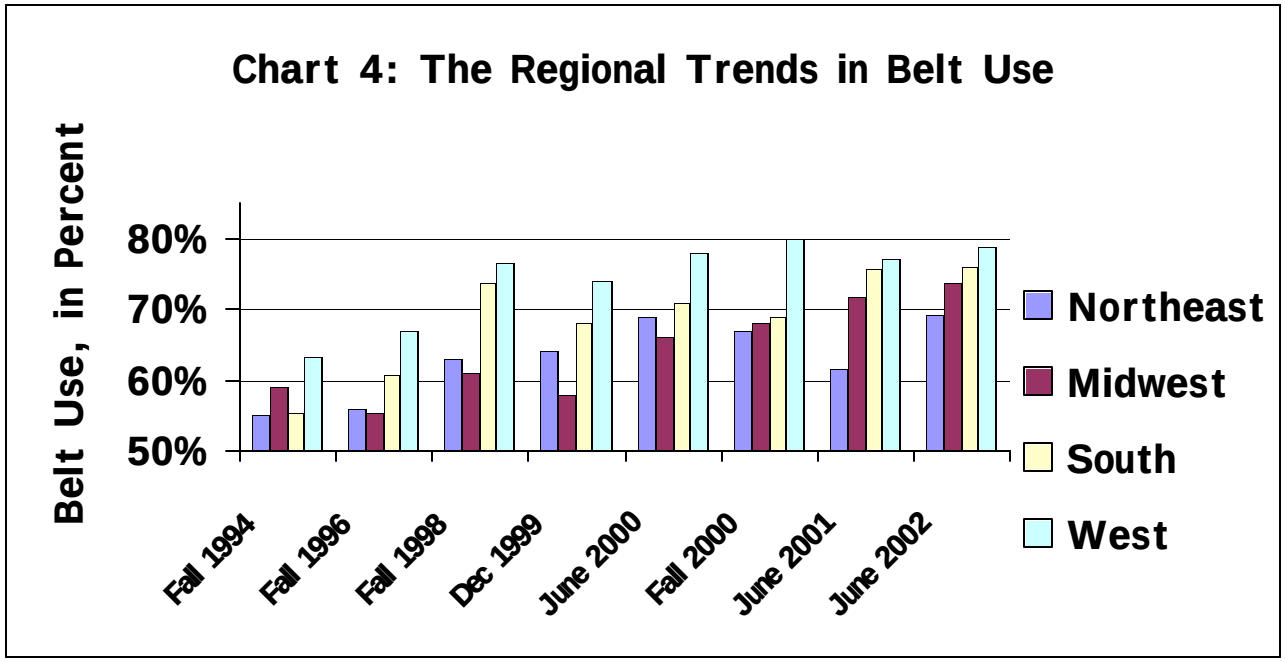
Date	Primary			Secondary		
	Use	Change, in ppts*	Conversion Rate	Use	Change, in ppts*	Conversion Rate
June 2000	77%			63%		
Fall 2000	77%	0	0%	64%	1	3%
June 2001	78%	1	4%	67%	3	8%
June 2002	80%	2	9%	69%	2	6%

***None of these changes are statistically significant. Conversion rates were not tested for significance.**

Source: National Center for Statistics and Analysis, NHTSA, National Occupant Protection Use Survey, 2000-2002.

C. Strong Gains in the Northeast.

Belt use increased by 7 percentage points in the Northeast, a statistically significant increase from 2001. The sharp gains made in the Northeast eliminated almost all regional differences. Previously the Northeast had statistically lower use than any other region. In 2002, the only significant pairwise comparison is that use is lower in the Northeast than in the West, which has the highest rate. Conversion rates are explained in Section II. F.



Source: National Center for Statistics and Analysis, NHTSA, National Occupant Protection Use Survey, 1994-2002.

Table 3: Belt Use by Region, 1994-2002

Date	Northeast			Midwest			South			West		
	Use	Change, in ppts	Conversion Rate	Use	Change, in ppts	Conversion Rate	Use	Change, in ppts	Conversion Rate	Use	Change, in ppts	Conversion Rate
Fall 1994	55%			59%			55%			63%		
Fall 1996	56%	1	2%	55%	-4	-10%	61%	6	13%	67%	4	11%
Fall 1998	63%	7	16%	61%	6	13%	74%	13	33%	76%	9	27%
Dec 1999	64%	1	3%	58%	-3	-8%	68%	-6	-23%	74%	-2	-8%
June 2000	69%	5	14%	66%	8	19%	71%	3	9%	78%	4	15%
Fall 2000	67%	-2	-6%	68%	2	6%	69%	-2	-7%	80%	2	9%
June 2001	62%	-5	-15%	72%	4	13%	76%	7	23%	77%	-3	-15%
June 2002	69%	7	18%	74%	2	7%	76%	0	0%	79%	2	9%

***These changes are significant with 95% confidence. Conversion rates were not tested for significance.**
Source: National Center for Statistics and Analysis, NHTSA, National Occupant Protection Use Survey, 1994-2002.

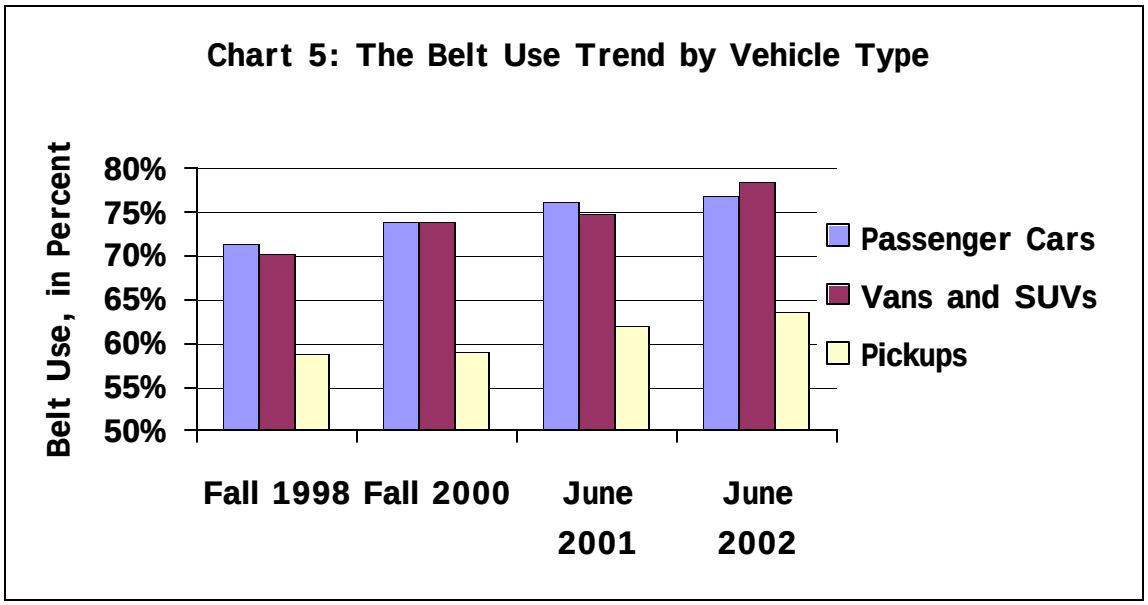
The regions are made up of the following states:

Figure 1: Definitions of NOPUS Regions

Northeast: ME, VT, NH, MA, RI, CT, NY, PA, NJ
Midwest: MI, OH, IN, IL, WI, MN, IA, MO, KS, NE, SD, ND
South: WV, MD, DE, VA, KY, TN, NC, SC, GA, FL, AL, MS, AR, LA, OK, TX, DC
West: AK, WA, OR, CA, NV, ID, UT, AZ, NM, CO, WY, MT, HI

D. Belt Use Increases Among Vans and SUVs.

Belt use increased by 3 percentage points among vans and SUVs, a statistically significant increase from 2001. These vehicles continue to have exhibit similar use rates to passenger cars, while pickups continue to lag statistically.



Source: National Center for Statistics and Analysis, NHTSA, National Occupant Protection Use Survey, 2000-2002.

Table 4: Belt Use by Vehicle Type, 1998-2002

Date	Passenger Cars			Vans and SUVs			Pickup Trucks		
	Use	Change, in ppts	Conversion Rate	Use	Change, in ppts	Conversion Rate	Use	Change, in ppts	Conversion Rate
Fall 1998	71%			70%			59%		
Fall 2000	74%	3	11%	74%	4	11%	59%	0	0%
June 2001	76%	2	8%	75%	1	4%	62%	3	7%
June 2002	77%	1	4%	78%	3	12%	64%	2	5%

***This change is significant with 95% confidence. Conversion rates were not tested for significance.**

Source: National Center for Statistics and Analysis, NHTSA, National Occupant Protection Use Survey, 2000-2002.

E. Helmet Use Declines Sharply.

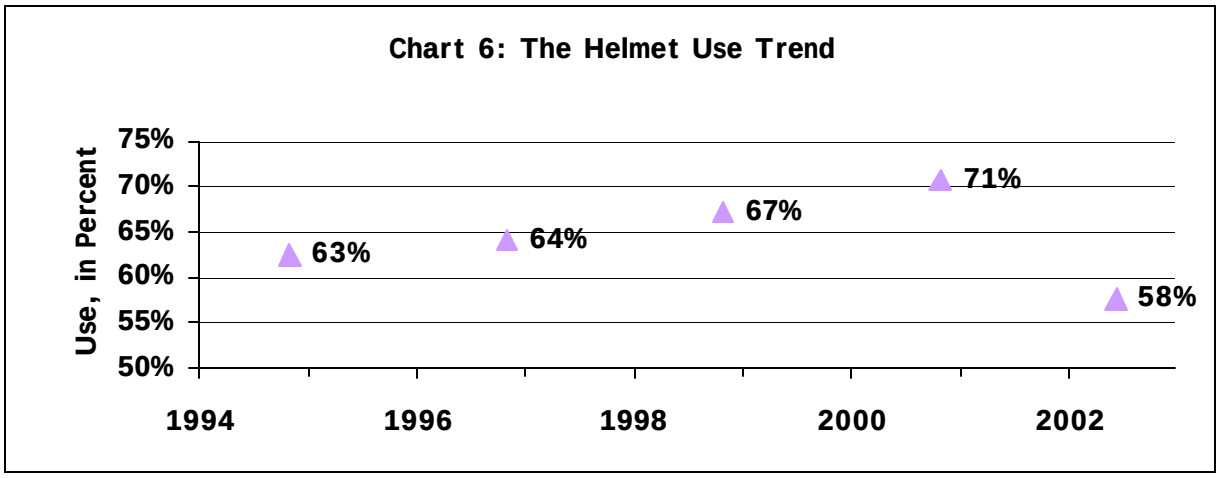
Because many of the helmets seen on the roads do not provide sufficient protection in a crash, starting in 1996 NOPUS categorized helmets into "legal" and "illegal" helmets, as defined in the Federal Motor Vehicle Safety Standard (FMVSS) 218. In 1996 and later, only the use of "legal" helmets is considered to constitute use. In 1994, the use of any helmet was considered to constitute use. It is illegal to sell as a motorcycle helmet anything that does not comply with FMVSS-218. While a sticker reading "DOT" is affixed to every compliant helmet, it is difficult to observe a sticker from the roadside. Consequently data collectors characterize as illegal, helmets that have features typically seen in illegal helmets, such as protruding objects (e.g. spikes in costume World War II vintage helmets) or small "beanie" helmets.

Helmet use declined 13 percentage points over two years, from 71% in 2000 to 58% in 2002. This drop is statistically significant, and corresponds to a striking 45% increase in nonuse.

Some of this decline might be due to the time of year in which use was observed. Use in 1994-2000 was observed in the fall months, while in 2002 it was observed in June. Use might be lower in warmer months, when the higher temperatures may make helmets less comfortable.

It should also be kept in mind that the decline in helmet use was over a two-year period. While NOPUS observes belt use every year, helmet use is only observed every other year. Observed helmet use declined on average by 6.5 percentage points per year in the period 2000 – 2002.

In addition, it should be kept in mind that the helmet estimates have large sampling errors, often five percentage points and higher. This is largely a consequence of the relatively small number of observations (900 drivers and 150 passengers). Although significance tests show that use declined, the magnitude of the decline may be smaller than that observed.



Source: National Center for Statistics and Analysis, NHTSA, National Occupant Protection Use Survey, 1994-2002.

Table 5: Helmet Use, 1994-2002

Date	Use	Change, in ppts	Conversion Rate
Fall 1994	63%		
Fall 1996	64%	2	4%
Fall 1998	67%	3	9%
Fall 2000	71%	3	11%
June 2002	58%	-13*	-44%

***This change is significant with 95% confidence. Conversion rates were not tested for significance.**
Source: National Center for Statistics and Analysis, NHTSA, National Occupant Protection Use Survey, 1994-2002.

F. What Factors Affect Belt and Helmet Use?

Table 6 gives the national seat belt and helmet use estimates and breaks them out by the six major categories recorded in the Moving Traffic Study: seating position, vehicle type, region, time of week, time of day, and ambient enforcement law. This table also gives the overall estimates of use of legal and illegal helmets. The 2001-2002 changes that are significant with 95% confidence are identified and conversion rates given in order to highlight categories that appear to have undergone substantial shifts in use.

"Weekday rush hour" is defined to be 8:00 – 9:30 AM and 3:30 – 6:00 PM, Monday through Friday. "Weekday non-rush hour" refers to the portions of the weekdays that don't occur in rush hour.

Table 6: Overall Belt and Helmet Use

Seat Belt Use								
Category	Use in June 2002		Use in June 2001		2001-2002 Change			
	Esti-mate	Std Error	Esti-mate	Std Error	Esti-mate	Std Error	Significant Increase?	Conversion Rate
Overall	75%	1.2%	73%	1.4%	2%	1.2%		7%
Primary Enforcement** (H)	80%	1.7%	78%	1.9%	2%	1.2%		9%
Secondary Enforcement** (L)	69%	1.1%	67%	2.3%	2%	1.9%		6%
Drivers	76%	1.2%	74%	1.4%	2%	1.3%		8%
Passengers	73%	1.4%	72%	1.5%	1%	1.4%		4%
Passenger Cars	77%	1.1%	76%	1.1%	1%	1.0%		4%
Vans and SUVs	78%	1.2%	75%	1.4%	3%	1.5%	Significant	12%
Pickup Trucks (L)	64%	2.1%	62%	2.6%	2%	2.6%		5%
Northeast (L)	69%	2.7%	62%	4.3%	7%	3.5%	Significant	18%
Midwest	74%	2.9%	72%	2.9%	2%	2.2%		7%
South	76%	2.2%	76%	1.9%	0%	1.8%		0%
West	79%	2.8%	77%	2.2%	2%	2.0%		9%
Weekday	75%	1.2%	73%	1.6%	2%	1.5%		7%
Weekend	76%	1.9%	74%	1.4%	2%	1.4%		8%
Weekday Rush Hour	76%	1.4%	75%	1.8%	1%	1.7%		4%
Weekday Non-Rush Hour	74%	1.3%	72%	1.9%	2%	1.9%		7%
Motorcycle Helmet Use								
Category	Use* in June 2002		Use* in Fall 2000		2000-2002 Change			
	Esti-mate	Std Error	Esti-mate	Std Error	Esti-mate	Std Error	Significant Increase?	Conversion Rate
Overall	58%	4.8%	71%	5.5%	-13%	6.6%	Significant	-45%
Primary Enforcement** (H)	69%	5.9%	81%	5.9%	-12%	7.9%		-63%
Secondary Enforcement** (L)	48%	6.0%	59%	5.9%	-11%	8.2%		-27%
Drivers	59%	4.9%	72%	5.1%	-13%	6.2%	Significant	-46%
Passengers	48%	7.5%	62%	9.9%	-14%	6.2%	Significant	-37%
Northeast	65%	8.4%	77%	11.4%	-12%	11.2%		-52%
Midwest	54%	9.7%	65%	10.4%	-11%	15.3%		-31%
South	62%	7.7%	62%	12.4%	0%	10.1%		0%
West	52%	12.0%	80%	8.7%	-28%	15.3%		-140%
Weekday	58%	7.3%	71%	8.5%	-13%	10.2%		-45%
Weekend	57%	3.7%	70%	7.6%	-13%	7.7%		-43%
Weekday Rush Hour	58%	7.2%	71%	9.1%	-13%	11.7%		-45%
Weekday Non-Rush Hour	58%	8.7%	71%	11.6%	-13%	13.3%		-45%
Legal Helmet	58%	4.8%	71%	5.5%	-13%	6.6%	Significant	-45%
Illegal Helmet	14%	2.8%	14%	2.8%	0%	3.8%		0%
No Helmet	28%	6.0%	15%	4.7%	13%	6.6%	Significant	15%

***When not specified, helmet use refers to the use of legal helmets.**

****Primary and secondary enforcement of seat belt laws.**

(H), (L): significantly higher (or lower) use than another member of the category.

Source: National Center for Statistics and Analysis, NHTSA, National Occupant Protection Use Survey, 2002.

Enforcement laws, geographic region, and vehicle type are significant factors in belt use. Seating position and times of day and week are not (using 95% confidence). Belt use is significantly higher in primary enforcement states. Use is lower in pickups, but is similar for passenger cars and vans and SUVs. These patterns are consistent with previous years. However, while use had been significantly lower in the Northeast than in any other region, its gains eliminated most regional differences in 2002. The only significant pairwise regional difference is that use is lower in the Northeast than in the West. These significance assessments were obtained using the calculations in Section II, "Assessing Statistical Significance".

Belt enforcement laws also significantly impact helmet use. This may be because of stronger helmet laws in states with stronger belt laws. In the future, we plan to assess whether the type of helmet law affects helmet use. Geographic region, times of day and week are not significant (at 95% confidence).

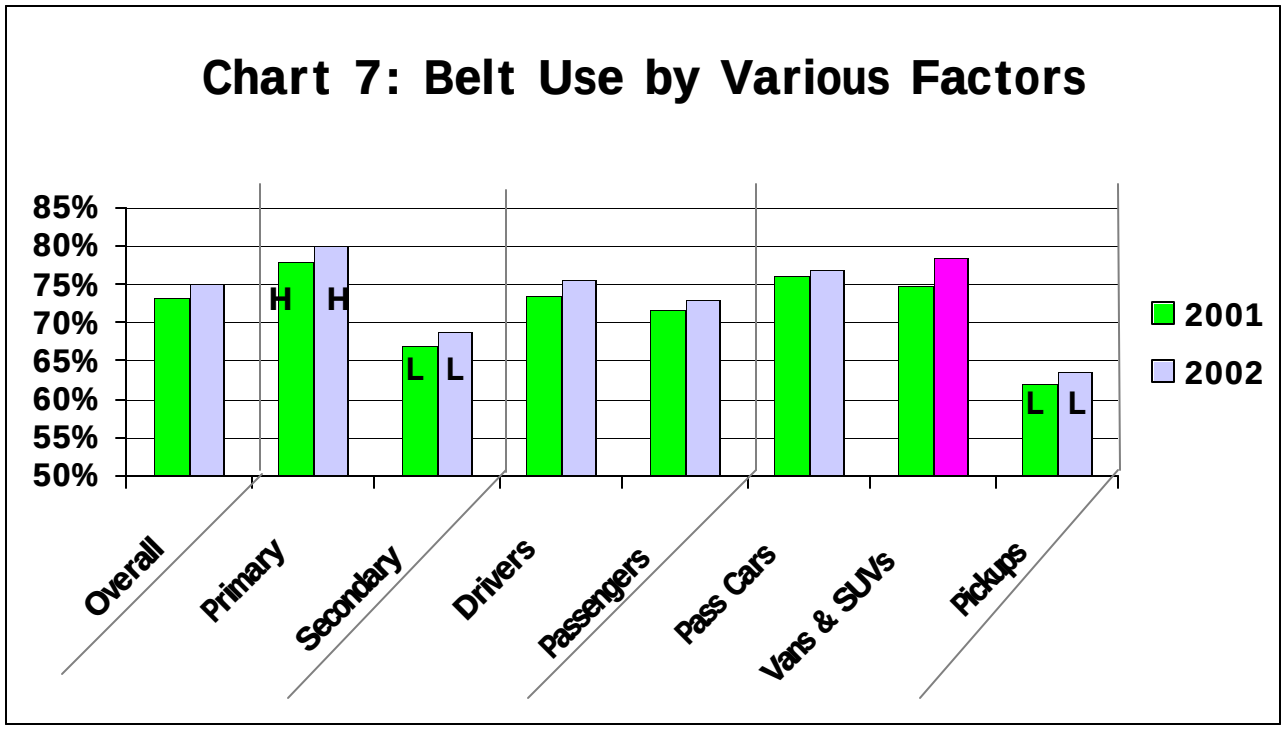
Figure 2: Factors Affecting Belt and Helmet Use

BELTS

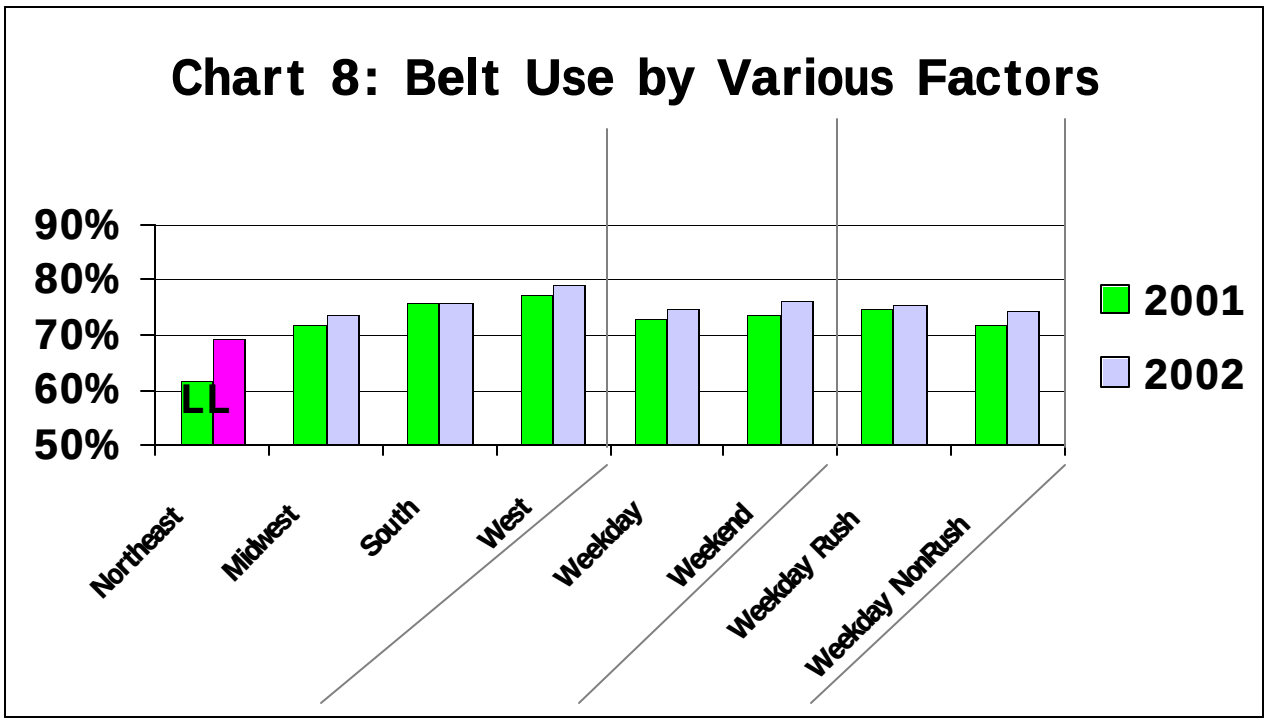
Significant Factors	Insignificant Factors
Enforcement Law	Seating position
Region	Times of day and week
Vehicle Type	

HELMETS: Only (belt) enforcement law is significant.

Statistically significant differences may reflect actual differences or sampling error. An insignificant difference may reflect equal use rates or a difference that is too small for the NOPUS sample to detect. In addition, there may be other factors that significantly impact use and were not collected in this survey.



H/L: significantly higher (or lower) use than another member of the category.
Use increased significantly in vans and SUVs.
Source: National Center for Statistics and Analysis, NHTSA, National Occupant Protection Use Survey, 2002.
H/L: significantly higher (or lower) use than another member of the category.



Use increased significantly in the Northeast.
Source: National Center for Statistics and Analysis, NHTSA, National Occupant Protection Use Survey, 2002.

II. Background

A. History

NHTSA began conducting the National Occupant Protection Use Survey (NOPUS) under the direction of NHTSA's National Center for Statistics and Analysis (NCSA) in 1994 to provide an observed assessment of the nation's belt use, and demographic detail that the agency uses to target belt use campaigns. The NOPUS is the only probability-based observational survey of belt use in the United States. All of the NOPUS results (from 1994 to present) can be found at http://www-nrd.nhtsa.dot.gov/departments/nrd-30/ncsa/AvailInf.html. Prior to 1994, the agency measured belt use from smaller non-probability observational surveys.

NHTSA also conducts a telephone survey of belt use, the Motor Vehicle Occupant Safety Survey (MVOSS), that provides demographic detail that cannot be observed and insight into the reasons people don't buckle up. [M] However, because it is not observational, the MVOSS is not the best indication of national use. (Because of respondent bias, the large number of part time users, and the tendency to over-report use, the MVOSS reports use rates that are about 10 percentage points higher than those from NOPUS.) In addition, NHTSA provides uniform standards and financial incentives for states to follow their use. [S3] However, because of cost-cutting measures allowed in the state surveys, they don't provide an adequate estimate of national use.

The NOPUS is conducted in two studies that provide different types of information. The results in this report are from the Moving Traffic Study, which provides a quick, general assessment of belt and helmet use, conducted at random road sites (at which traffic is typically in motion). The NOPUS Controlled Intersection Study provides greater demographic detail, such as belt use by race/ethnicity and gender, and estimates of child seat use. This study is conducted at intersections controlled by a stop sign or stoplight, at which slowed or stopped traffic permits more detailed data collection. Belt use is higher at controlled intersections (presumably because traffic controls are more common in urbanized areas). Consequently, estimates from the Controlled Intersection Study are adjusted, using the Moving Traffic Study, to reflect belt use on all types of roads and speeds. The Controlled Intersection Study is conducted about every two years. The most recent results, collected in June 2002, will be published in the fall of 2002. Both studies use the same sample.

B. Survey Design

The NOPUS uses a multi-stage probability sample, selected in 1994, to ensure efficient collection of nationally representative data. In the first stage of the sample selection, counties were grouped by region (Northeast, Midwest, South, West), level of urbanization (metropolitan or not), and level of belt use (high,

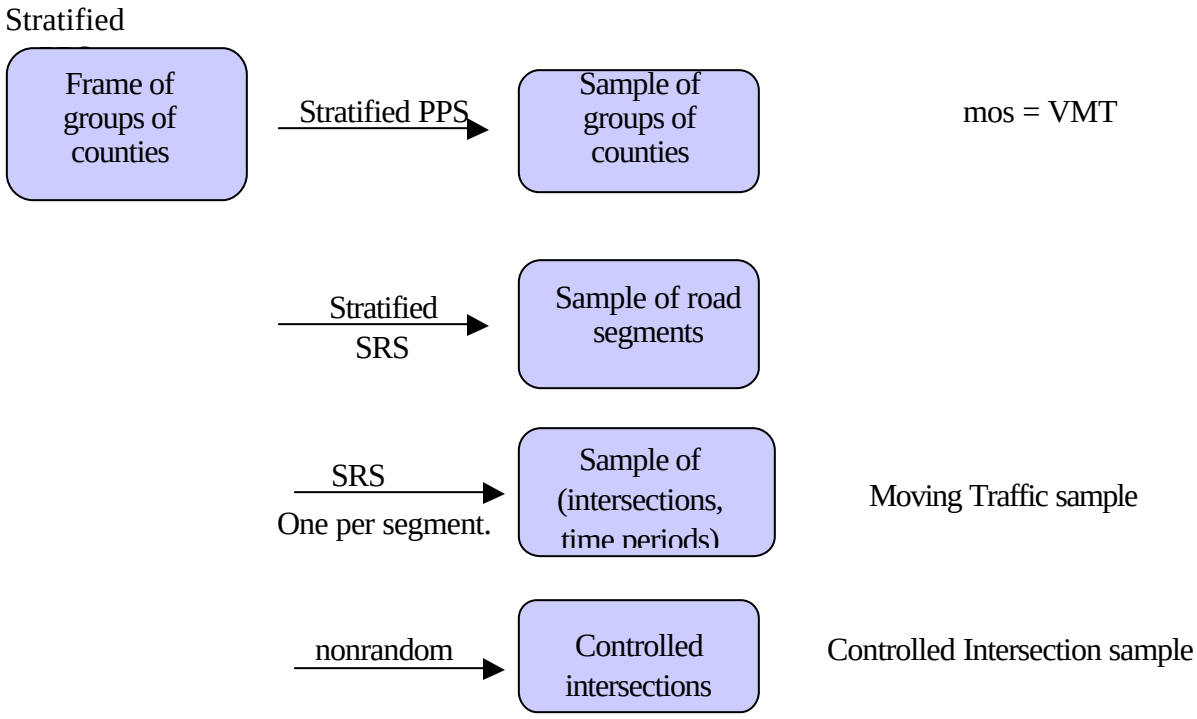
medium, or low). Fifty counties or groups of counties (called primary sampling units or PSUs) were selected from these strata based on the estimated annual vehicle miles traveled. In the next stage, within each PSU a probability sample of road segments was selected from two categories: major roads and local roads. Road segments are typically a few miles in length, varying between about a tenth of a mile and 30 miles, and may only represent a small portion of the roadway (e.g. on an interstate). There may be a small number of intersections and ramps on any given segment. A direction of travel and a time period long enough to permit observation for both studies were selected randomly for each segment. (All time periods were between 8 AM and 6 PM, Sunday through Saturday. Data collection takes 30 minutes for the Moving Traffic Study and 40 minutes for the Controlled Intersection Study.) Sites with low selection probabilities are assigned multiple time periods, up to four, in order not to give observations from a single period undue influence. In addition, an intersection, which might or might not be controlled, was randomly selected on each noninterstate segment, and an exit from each interstate segment.

The Moving Traffic Study was conducted near the selected intersection for the noninterstate segments, in the chosen direction of travel, during the chosen time period. At interstate sites, either the moving vehicle observation method was conducted on the segment or the exit ramp method at the selected ramp.

The data collectors then attempted to find a suitable site on the segment at which to conduct the Controlled Intersection Study. For interstate segments, this study was conducted at the ramp if it had a controlled intersection (as many do), and was otherwise not conducted. For noninterstate sites, data collectors attempted to find a controlled intersection on the segment. If they succeeded within a reasonable time, they conducted the Controlled Intersection Study at this site, and so this last phase of sampling is not random. (The Controlled Intersection Study did not use the moving vehicle data collection method.)

The following figure summarizes the sample design for NOPUS's two studies.

Figure 3: The NOPUS Sample



In particular, the Moving Traffic Study was conducted on all selected segments, while the Controlled Intersection Study was conducted on many of these (often at a different observation site). So when viewed as samples of segments, the Controlled Intersection sample is a large subsample of the Moving Traffic sample.

The original NOPUS sample was selected in 1994 and consisted of about 4,000 roadway sites in the Moving Traffic Study. Starting in the 2000 data year, a subsample of 2,000 was used to reduce cost. Each year, sites on which observations cannot be made (e.g. because of road construction) are dropped from the sample and replacement sites of the same character are chosen, if possible. There are occasionally a few sites for which suitable replacements cannot be found. That is, we are essentially using a subsample of the original 1994 sample. We expect to select a new sample (i.e. new Moving Traffic and Controlled Intersection samples), that better reflects current road segments in the next few years.

Sample weights are computed for each site as the inverse of the site's selection probability. Observed counts are adjusted, using the segment lengths, estimated average traffic speeds, numbers of lanes observed at each site, and, in the case of moving vehicle data collection, the speed of the observation vehicle, to reflect the approximate number of vehicles on the segment during the period. (See the formula in Figure 4 below.) These adjustments ensure that estimates provide a "snapshot" of belt use on the selected road segments.

Nonresponse factors are used to address sites for which replacements could not be found or that could not be observed in the data collection period (e.g. due to darkness). Data are weighted according to the

sample weights and these adjustment factors. That is, except for nonresponse factors, belt use (in any given category) is estimated in the Moving Traffic Study as

Figure 4: The Moving Traffic Estimator

$$\text{belt use} = \frac{\sum_{\text{sites } i} w_i \times \frac{\text{no. vehicles on segment during obs period}}{\text{no. vehicles observed at site } i} \times \text{no. observed belted at site } i}{\sum_{\text{sites } i} w_i \times \frac{\text{no. vehicles on segment during obs period}}{\text{no. vehicles observed at site } i} \times \text{no. observed at site } i}$$

where w_i is the sample weight of site i, and $\frac{\text{no. vehicles on segment during obs period}}{\text{no. vehicles observed}}$ is taken to be $\frac{\text{no. lanes on segment}}{\text{no. lanes observed}}$ times

$$\begin{cases} \frac{\text{number of vehicles counted on interstate in 10 min.}}{\text{number of vehicles observed in 10 min.}} & \text{if the road is an interstate observed from an exit ramp} \\ \frac{\text{length of segment}}{\text{average speed of traffic - speed of observation vehicle}} & \text{if the road is an interstate observed from a moving vehicle} \\ \frac{\text{length of segment}}{\text{average speed of traffic}} & \text{otherwise} \end{cases}$$

The "snapshot" estimator is a conceptually simple estimator (with units in percent persons) and reflects actual behavior on the road during the data collection. Those who spend more time on the road are more likely to be observed. (In contrast, non-observational surveys, such as telephone surveys, often treat all respondents without regard to the amount of time they spend on the road.)

Since NOPUS uses a complex sample design, its sampling errors are estimated with a procedure that can handle this complexity. Variances are estimated as that between PSUs in the same stratum, except in certainty PSUs, where the between-site variances are estimated. These component variances are estimated using jackknife replication, and are calculated using the statistical package WesVar.

Estimates are rounded to the nearest percentage point for calculations of change estimates and conversion rates. In addition, legal, illegal, and no helmet use estimates might not sum to 100% because of rounding.

C. Data Collection

Use is assessed in NOPUS through observation. At non-interstate sites in the Moving Traffic Study, teams of two observers observe traffic from the side of each selected roadway for 30 minutes. They use hand-held clicker counters, similar to those used to estimate attendance at large events, to count belted and unbelted motor vehicle occupants in a way that permits counting even in fast-moving traffic. Only shoulder belt use of drivers and right front passengers are observed, due to the difficulty of observing use for other seating positions and belt types in a moving vehicle. Use is observed only in passenger vehicles that do not have commercial or government markings. For instance, ambulances, police cars, taxis, buses, and passenger vehicles that have commercial writing on them (such as a van marked "Steve's Painting") are excluded. In addition, observers count the numbers of motorcycle drivers and passengers that are using a legal, illegal (such as a bicycle helmet), or no helmet. In heavy traffic, use is observed in only one lane and inflated to reflect all lanes. Data are collected at certain interstate sites from moving vehicles (see "New Data Collection Protocol on Interstate Roadways" below). At other interstate sites, use is observed at the selected exit ramp using the same methodology as for the noninterstate sites. Approximately 150,000 drivers and 50,000 passengers of motor vehicles, and approximately 900 drivers and 150 passengers of motorcycles, were observed. See [C1] or [C2] for the Controlled Intersection Study's data collection protocol.

In summary data collectors observe the following.

Figure 5: What Data Collectors Observe.

BELTS		HELMETS	
Observe shoulder belt use		Observe use of legal and illegal helmets	
of	driver and right front passenger	of	driver and passenger
in	passenger vehicles with no commercial or government markings		
from	roadsides, ramps, and moving vehicles	from	roadsides, ramps, and moving vehicles
during	daylight hours.	during	daylight hours.

Observers are trained in techniques to collect this data as accurately as possible. Belt use can be difficult to assess in fast-moving vehicles, when an occupant's shirt and belt are close in color, or through sun glare off a windshield or moving windshield wipers. Vehicle type (passenger car, van or SUV, and pickup truck) must be categorized quickly from sight, and collectors must be able to manipulate multiple clicker buttons, each dedicated to a particular vehicle type, seating position, and belted status, quickly. It is fairly easy to assess whether a helmet is "legal" (conforms to DOT standards) or not. (See the section "Legal and Illegal Helmets" below for these definitions.) Data collectors receive training each year, whether they are collecting for the first time or have participated for several years, to ensure the highest quality possible.

C1. New Data Collection Protocol on Interstate Roadways

The 2002 data year marks the beginning of a new methodology that should improve observation of belt and helmet use on interstates. Collecting at these sites is challenging because data collectors cannot observe from the side of the roadway, as they do at other sites. In previous years, NOPUS had used exit ramps as proxy observation sites. However belt use is typically lower on exit ramps than on interstates because of the greater incidence of occupants taking short trips. [M] In addition, the small number of occupants observed on ramps, compared to those that were on the interstate, leads to large adjustment factors and high variability. To address these problems, starting this year, use was observed from moving vehicles on select interstate road segments.

For these interstate segments, the pair of data collectors repeatedly drove the entire length of the segment (typically a few miles) during the 30-minute data collection period. They drove slightly more slowly than the prevailing traffic in order to observe as many vehicles as possible. The driver in the team identified an approaching vehicle or motorcycle, and the passenger entered the belt or helmet use into a Personal Data Assistant (PDA) as the vehicle or motorcycle passed the observation vehicle. The PDAs were custom programmed so that data could be entered easily with the touch of a finger, automatically reading back each piece of information entered (e.g. "passenger car") as it was entered to permit rapid data entry without looking down at the PDA. Data from the PDAs were downloaded to computers over phone lines, which omitted any keying errors that can occur with manual entry.

To smooth the transition to the new methodology, data was collected using the moving vehicle data collection at 51 of the 398 interstate sites and using the ramp methodology at the remaining sites. It is planned that the proportion using the moving vehicle method will be increased in subsequent years until all interstate sites use this method.

This new method produces more accurate estimates because it observes use on the selected road segment. Since the exit ramp method underestimates use, the NOPUS estimates from 1994 – 2002 all understate of use. However, the amount of understatement is believed to be small. Likewise, year-to-year changes between the 2001 data year and a few years from now, when the new method is implemented at all interstate sites, overstate the changes. Again, the amount of overstatement is believed to be small.

D. Sources of Possible Bias

Estimates from this survey measure helmet use in daylight hours in June and shoulder belt use among drivers and right front passengers of passenger vehicles during daylight hours in June. Furthermore the use on some interstates was observed at exit ramps. Although these restrictions were made in order to make data collection feasible, they might result in slight overestimates or underestimates of use and this bias cannot be quantified. Fatality data from NHTSA's Fatality Analysis Reporting System indicates that use might be lower at night, and data from NHTSA's Crashworthiness Data System indicates it might be lower among

lap belt users. The new interstate data collection protocol was implemented to reduce bias in interstate measurements. It is also possible that the June observation might account for some of the drop in helmet use in 2002, since previous measurements were taken in the fall months.

The data in this report was collected between June 3, 2002 and June 22, 2002. All states except California conducted seat belt campaigns at the end of May. The nature of these campaigns varied with the state, but usually involved increased enforcement of seat belt laws and advertisements on state belt laws. The NOPUS estimates might reflect temporary or lasting effects of these campaigns.

E. Legal and Illegal Helmets

Federal Motor Vehicle Safety Standard 218 provides a standard for motorcycle helmets to provide sufficient protection in a crash. It is illegal to sell a helmet that does not meet this standard as a motorcycle helmet. However, some helmets, such as novelty and costume helmets continue to be worn as motorcycle helmets. Consequently, NOPUS estimates both the use of "legal" helmets (those that meet the government standard) and "illegal" helmets (those that don't). Since 1996, NOPUS has considered only legal helmets to constitute use. (In 1994, NOPUS considered any helmet to constitute use.)

It is fairly easy to tell whether a helmet is legal or illegal in moving traffic. Although legal helmets are identified by a sticker labeled "DOT" on the back of the helmet, this is difficult to observe in traffic, so data collectors categorize helmets as legal and illegal according to characteristics commonly seen in illegal helmets, such as protrusions (e.g. spikes in World War II vintage helmets), a small area (like a beanie), or a thin chin strap.

F. Conversion Rates

The best measure of improvement in belt use is the *conversion rate*, which is the rate of decrease of belt nonuse from one year to the next. For instance, belt use nationwide increased from 73% in 2001 to 75% in 2002. If one thinks of 73% of the nation's population as belt "users", and its remaining 27% as "nonusers", then nonusers decreased from comprising 27% of the population in 2001 to 25% in 2002 a 7 percent reduction (8 percent when one more significant digit is used). That is, the nation "converted" 7% of its population that was not using belts in 2001 to using belts in 2002. (The user/nonuser categorization is a bit simplistic. According to NHTSA's Motor Vehicle Occupant Safety Survey, most of us are part-time users. [M] However the use/nonuse categorization is helpful for thinking about conversion rates.) Table 7 shows that about 8-9% of belt nonusers have been converted to users each year.

Table 7: Belt Conversion, 1994-2002

Date	Use	Change, in ppts	Conversion Rate
Fall 1994	58%		
Fall 1996	61%	3	7%
May 1998	62%	1	3%
June 1998	65%	3	8%
Fall 1998	69%	4	11%
Dec 1998	70%	1	3%
Dec 1999	67%	-3	-10%
June 2000	71%	4	12%
Fall 2000	71%	0	0%
June 2001	73%	2	7%
June 2002	75%	2	7%

Source: National Center for Statistics and Analysis, NHTSA, National Occupant Protection Use Survey, 1994-2002.

Conversion rates are negative when use declines. For instance, helmet use (the use of legal helmets) dropped from 71% in 2001 to 58% in 2002. This corresponds to a 45% increase of "nonusers", from 29% nonusers in 2001 to 42% in 2001. That is, nonusers of helmets decreased by –45%. In general, declines in observed use may correspond to actual declines in use or may be due to sampling error. The tables indicate yearly changes (or changes over two years for helmets) are statistically significant.

Conversion rates provide a better measure of improvement than percentage point or percentage increases in use. It would be moderately challenging for the West, with its 79% use rate in 2002, to raise belt use by one percentage point further (to 80%), since it would have to convert 5% of its nonusers. (In addition, it would be difficult to detect such a small increase with NOPUS's sampling error.) On the other hand, the Northeast would only have to convert 3% of its nonusers to raise its belt use one percentage point from its 2002 rate of 69%. That is, conversion rates assess improvement in a way that does not penalize regions or other categories that already exhibit high use rates.

G. Assessing Statistical Significance

Because NOPUS is a probability sample, one can determine whether measured differences more plausibly reflect actual differences or the natural variation that occurs when sampling. The 2002 data year marks the implementation of a new methodology that improves these assessments of statistical significance. One can also quantify ranges in which actual belt and helmet use lie with a quantified degree of confidence in these assertions.

One can determine whether a change from the 2001 data year (such as the 2 percentage point increase in national belt use) is statistically significant as follows. The difference is statistically significant with 95% confidence if it is larger than 1.96 times the standard error on the 2001-2002 change. For instance the national increase is not statistically significant with 95% confidence, since the difference of 2 percentage points does not exceed 1.96 times the standard error of 1.2 percentage points. This means that although our measured rate increased (from 73% to 75%), this could be an artifact of having observed belt use on a sample rather than observing all occupants in all vehicles at all times in 2002. Although not statistically significant with 95% confidence, the increase is significant at a slightly lower confidence level (89%), and so one can be fairly certain that belt use increased in 2002.

Standard errors of changes are only provided on changes from the reference period (year-to-year changes for belts and changes from two years ago for helmets). In the future, we hope to provide standard errors that more directly test the significance of other differences, such as that between belt use in rush hour and non-rush hour. In the meantime, conservative estimates of standard errors on changes may be obtained where they are not provided by taking the square root of the sum of the squares of the standard errors of the two estimates. For instance the standard error on the increase of 2 percentage points between rush hour and non-rush hour is approximately $\sqrt{.01^2 + .01^2} = .014$, or 1.4 percentage points. Since the difference between rush and non-rush hour is less than 1.96 times this, belt use is not significantly higher in rush hour (at 95% confidence).

One can determine the likely range in which the actual value of belt or helmet use lies as follows. The margin of error of an estimate is 1.96 times the standard error, and one can assert with 95% confidence that actual use is within the margin of error of the estimate. For instance, the margin of error on the national rate of 75% is 2.4 percentage points, meaning that in 95% of all possible samples we could have chosen (using the same design), the estimated national rate would lie within 2.4 percentage points of the actual rate.

III. Detailed Belt and Helmet Estimates

The remaining tables break out seat belt and helmet use further, into various two-way tables, by vehicle type and seating position, by type of enforcement law and vehicle, by region and vehicle type, and by time of week and day, and vehicle type.

See Figure 1 in Section I for the definitions of the NOPUS regions. "Weekday rush hour" is defined to be 8:00 – 9:30 AM and 3:30 – 6:00 PM, Monday through Friday. "Weekday non-rush hour" refers to other weekday times.

A. By Vehicle Type and Seating Position

Table 8: Belt and Helmet Use by Vehicle Type and Seating Position

Belt Use								
Category	Use in June 2002		Use in June 2001		2001-2002 Change			
	Estimate	Std Error	Estimate	Std Error	Estimate	Std Error	Significant Increase?	Conversion Rate
Passenger Cars	77%	1%	76%	1%	1%	1%		4%
Drivers	78%	1%	77%	1%	1%	1%		4%
Passengers	74%	1%	74%	1%	0%	1%		0%
Vans and SUVs	79%	1%	75%	1%	4%	1%	Significant	16%
Drivers	79%	1%	75%	1%	4%	1%	Significant	16%
Passengers	78%	1%	74%	2%	4%	2%		15%
Pickup Trucks	65%	2%	62%	3%	3%	3%		8%
Drivers	66%	2%	62%	3%	4%	3%		11%
Passengers	63%	3%	62%	2%	1%	2%		3%
Motorcycle Helmet Use								
Category	Use in June 2002		Use in Fall 2000		2000-2002 Change			
	Estimate	Std Error	Estimate	Std Error	Estimate	Std Error	Significant Increase?	Conversion Rate
Drivers								
Legal helmet	59%	5%	72%	5%	-13%	6%	Significant	-46%
Illegal helmet	14%	3%	13%	3%	1%	4%		
No helmet	27%	6%	14%	4%	13%	6%	Significant	
Passengers								
Legal helmet	48%	8%	62%	10%	-14%	6%	Significant	-37%
Illegal helmet	14%	6%	19%	6%	-5%	4%		
No helmet	38%	8%	19%	8%	19%	6%	Significant	

Source: National Center for Statistics and Analysis, NHTSA, National Occupant Protection Use Survey, 2002.

B. By Enforcement Law and Vehicle Type

Table 9: Belt and Helmet Use by Enforcement Law and Vehicle Type

Belt Use								
Category	Use in June 2002		Use in June 2001		2001-2002 Change			
	Estimate	Std Error	Estimate	Std Error	Estimate	Std Error	Significant Increase?	Conversion Rate
Primary	80%	1.7%	78%	1.9%	2%	1.2%		9%
Passenger Cars	82%	1.7%	81%	1.7%	1%	1.1%		5%
Vans and SUVs	83%	1.3%	79%	1.8%	4%	1.3%	Significant	19%
Pickup Trucks	71%	2.7%	70%	3.5%	1%	2.8%		3%
Secondary	69%	1.1%	67%	2.3%	2%	1.9%		6%
Passenger Cars	71%	1.1%	71%	1.9%	0%	1.4%		0%
Vans and SUVs	73%	1.4%	70%	2.2%	3%	2.3%		10%
Pickup Trucks	55%	2.0%	50%	3.6%	5%	3.8%		10%

Motorcycle Helmet Use								
Category	Use in June 2002		Use in Fall 2000		2000-2002 Change			
	Estimate	Std Error	Estimate	Std Error	Estimate	Std Error	Significant Increase?	Conversion Rate
Primary								
Legal helmet	69%	5.9%	81%	5.9%	-12%	7.9%		-63%
Illegal helmet	19%	3.7%	17%	5.3%	2%	6.5%		
No helmet	13%	6.0%	2%	1.5%	11%	6.0%		
Secondary								
Legal helmet	48%	6.0%	59%	5.9%	-11%	8.2%		-27%
Illegal helmet	10%	3.8%	11%	2.9%	-1%	4.3%		
No helmet	42%	8.3%	30%	5.7%	12%	9.8%		

Source: National Center for Statistics and Analysis, NHTSA, National Occupant Protection Use Survey, 2002.

C. By Region and Vehicle Type

Table 10: Belt and Helmet Use by Region and Vehicle Type

Belt Use								
Category	Use in June 2002		Use in June 2001		2001-2002 Change			
	Estimate	Std Error	Estimate	Std Error	Estimate	Std Error	Significant Increase?	Conversion Rate
Northeast	69%	2.7%	62%	4.3%	7%	3.5%	Significant	18%
Passenger Cars	71%	2.5%	67%	2.3%	4%	1.9%	Significant	12%
Vans and SUVs	72%	2.7%	63%	4.2%	9%	3.8%	Significant	24%
Pickup Trucks	50%	5.0%	38%	8.6%	12%	8.4%		19%
Midwest	74%	2.8%	72%	2.9%	2%	2.2%		7%
Passenger Cars	75%	2.7%	74%	2.4%	1%	2.1%		4%
Vans and SUVs	76%	2.8%	73%	2.8%	3%	2.6%		11%
Pickup Trucks	64%	4.0%	62%	4.9%	2%	3.3%		5%
South	76%	2.3%	76%	1.9%	0%	1.8%		0%
Passenger Cars	78%	2.1%	79%	2.0%	-1%	1.6%		-5%
Vans and SUVs	81%	2.1%	78%	1.9%	3%	2.1%		14%
Pickup Trucks	65%	3.9%	67%	4.1%	-2%	4.4%		-6%
West	79%	2.8%	77%	2.2%	2%	2.0%		9%
Passenger Cars	81%	2.9%	81%	2.7%	0%	2.2%		0%
Vans and SUVs	82%	2.7%	81%	2.3%	1%	1.7%		5%
Pickup Trucks	69%	3.4%	65%	2.4%	4%	2.4%		11%
Motorcycle Helmet Use								
Category	Use in June 2002		Use in Fall 2000		2000-2002 Change			
	Estimate	Std Error	Estimate	Std Error	Estimate	Std Error	Significant Increase?	Conversion Rate
Northeast								
Legal helmet	65%	8.4%	77%	11.4%	-12%	11.2%		-52%
Illegal helmet	26%	6.4%	14%	4.3%	12%	7.2%		
No helmet	9%	8.1%	9%	9.2%	0%	5.0%		
Midwest								
Legal helmet	54%	9.7%	65%	10.4%	-11%	15.3%		-31%
Illegal helmet	13%	6.4%	8%	5.7%	5%	6.8%		
No helmet	33%	8.5%	26%	14.3%	7%	15.0%		
South								
Legal helmet	62%	7.7%	62%	12.4%	0%	10.1%		0%
Illegal helmet	14%	4.0%	17%	6.1%	-3%	7.6%		
No helmet	25%	7.5%	21%	8.7%	4%	6.7%		
West								
Legal helmet	52%	12.0%	80%	8.7%	-28%	15.3%		-140%
Illegal helmet	9%	5.0%	16%	7.7%	-7%	8.6%		
No helmet	40%	16.2%	4%	3.1%	36%	16.9%	Significant	

Source: National Center for Statistics and Analysis, NHTSA, National Occupant Protection Use Survey, 2002.

D. By Time of Day and Week, and Vehicle Type

Table 11: Belt and Helmet Use by Time of Day and Week, and Vehicle Type

Belt Use								
Category	Use in June 2002		Use in June 2001		2001-2002 Change			
	Estimate	Std Error	Estimate	Std Error	Estimate	Std Error	Significant Increase?	Conversion Rate
Weekday	75%	1.2%	73%	1.6%	2%	1.5%		7%
Passenger Cars	77%	1.2%	76%	1.3%	1%	1.2%		4%
Vans and SUVs	78%	1.3%	74%	1.7%	4%	1.7%	Significant	15%
Pickup Trucks	63%	2.0%	62%	3.2%	1%	3.2%		3%
Weekend	76%	1.9%	74%	1.4%	2%	1.4%		8%
Passenger Cars	78%	1.9%	76%	1.6%	2%	1.7%		8%
Vans and SUVs	79%	2.0%	76%	1.3%	3%	1.8%		13%
Pickup Trucks	66%	3.1%	63%	2.7%	3%	2.1%		8%
Weekday Rush	76%	1.4%	75%	1.8%	1%	1.7%		4%
Passenger Cars	78%	1.3%	77%	1.9%	1%	1.8%		4%
Vans and SUVs	78%	1.5%	76%	1.9%	2%	2.1%		8%
Pickup Trucks	64%	2.6%	67%	3.8%	-3%	4.1%		-9%
Weekday Non-Rush	74%	1.3%	72%	1.9%	2%	1.9%		7%
Passenger Cars	76%	1.3%	76%	1.3%	0%	1.4%		0%
Vans and SUVs	78%	1.3%	73%	2.0%	5%	2.1%	Significant	19%
Pickup Trucks	62%	2.1%	59%	3.7%	3%	3.9%		7%
Motorcycle Helmet Use								
Category	Use in June 2002		Use in Fall 2000		2000-2002 Change			
	Estimate	Std Error	Estimate	Std Error	Estimate	Std Error	Significant Increase?	Conversion Rate
Weekday								
Legal helmet	58%	7.3%	71%	8.5%	-13%	10.2%		-45%
Illegal helmet	10%	2.8%	19%	6.0%	-9%	6.9%		
No helmet	32%	8.9%	10%	4.2%	22%	9.0%	Significant	
Weekend								
Legal helmet	57%	3.7%	70%	7.6%	-13%	7.7%		-43%
Illegal helmet	19%	4.2%	11%	2.0%	8%	4.5%		
No helmet	23%	4.6%	19%	7.7%	4%	7.5%		
Weekday Rush								
Legal helmet	58%	7.2%	71%	9.1%	-13%	11.7%		-45%
Illegal helmet	13%	3.5%	18%	8.3%	-5%	9.6%		
No helmet	29%	8.4%	11%	4.4%	18%	9.2%		
Weekday Non-Rush								
Legal helmet	58%	8.7%	71%	11.6%	-13%	13.3%		-45%
Illegal helmet	9%	3.8%	20%	7.1%	-11%	7.8%		
No helmet	33%	10.6%	9%	6.2%	24%	11.5%	Significant	

Source: National Center for Statistics and Analysis, NHTSA, National Occupant Protection Use Survey, 2002.

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