



# SAFETY PROJECT BRIEF

**PROJECT BRIEF S05**

**OCTOBER 2010**

## **Design of the In-Vehicle Driving Behavior and Crash Risk Study: The SHRP 2 Naturalistic Driving Study**

The SHRP 2 Safety effort will, for the first time ever, allow us to record and study the driving behaviors of a large sample of drivers in their personal vehicles—a naturalistic study. . . . It will also produce an incredible database for even more advanced analyses for at least a decade after the current study ends.

*Forrest Council*

*Senior Research Scientist, Highway Safety Research Center, University of North Carolina  
Chair, SHRP 2 Safety Technical Coordinating Committee*

*This document is drawn from the final report prepared by researchers for project S05. The objective of this project was to design the in-vehicle driving behavior and crash risk study, also known as the SHRP 2 naturalistic driving study (NDS), which will collect real-world driving behavior for a two-year period beginning in 2010. Projects comprising the NDS include S06: Technical Coordination and Independent Quality Assurance for Field Study, S07: In-Vehicle Driving Behavior Field Study (six sites), S04A: Roadway Information Database Development and Technical Coordination and Quality Assurance of the Mobile Roadway Data Collection, and S04B: Mobile Roadway Data Collection. The final report includes a summary of the key areas of the planning study for the SHRP 2 NDS. The report will be available early 2011 in print and electronic format. The Responsible Staff Officer for this project is Dr. Kenneth Campbell, who can be contacted at [kcampbell@nas.edu](mailto:kcampbell@nas.edu).*

Fundamental safety research could lead to significant improvements in roadway safety. It is estimated that each 1% improvement in safety results in 340 saved lives, 30,000 fewer injuries, and \$2.3B in annual cost savings(1).

The SHRP 2 NDS represents a large-scale effort to collect data to better understand how drivers interact with and adapt to an extensive array of factors (e.g., the vehicle, traffic environment, roadway characteristics, traffic control devices, and the natural environment), and assess the differences in collision risk associated with each of these factors and interactions. By understanding how risk factors influence safety on our roadways, innovative countermeasures can be employed to improve our ability to design and build safer roadways and vehicles, navigate difficult environmental conditions, and teach future generations how to engage in safer driving practices.

### **Study Design**

The study design elements are defined from a variety of perspectives and are intended to facilitate researchers' ability to address as many of a comprehensive set of categorized research questions as feasible. The research questions were collected early in the process and synthesized into categories such as

road departure, general intersection, head-on crashes, and general driver behavior. The report discusses each of the elements and the process for participant recruitment.

There are two broad aspects to the NDS design: (1) contractor-site selection and (2) participant-vehicle sample design. Contractors were selected at six sites: Erie County, New York; Seattle, Washington; Central Pennsylvania; Central Indiana; Tampa Bay, Florida; and Durham, North Carolina. Volunteer drivers will be selected by age, gender, and vehicle type and will participate for either one or two years. Table 1 shows the participant categories by age and gender. Passenger cars and light trucks will be the focus of the study.

### **Data Collection**

Several categories of data will be collected including driver assessments, time series data and video from the onboard data acquisition system (DAS), participant demographics, vehicle inventory, and crash investigations. Primary participants will be assessed on a variety of driving-related skills and attributes including: visual perception, visual-cognitive ability, cognitive ability, psychomotor ability, physical ability, health and medication status, psychological factors, driving-knowledge, and driver history. The DAS, which will continuously record driver behavior and vehicle kinematics, will include a wide variety of sensors such as: four video cameras, velocity and acceleration sensors, location from a global positioning system (GPS), forward radar, and a passive alcohol sensor. Machine vision tools will also be incorporated into the DAS, including a lane tracker and an eyes-forward monitor. Crash and crash site investigations will be conducted after certain crashes to gather more detailed data surrounding particular events of interest. Further details on the data being collected—including specific driver assessment tests, DAS details, and criteria and procedures for crash investigations—will be available in the final report.

### **Participant Protection and Data Management**

Institutional review board (IRB) approval of human-subject research is a critical task that the project team undertook promptly after the project began. Of paramount concern in this effort was the need for this task to maintain close coordination

**Table 1: Participant Gender and Age**

Gender and Age Range	Age Range Description	One-Year Participants	Two-Year Participants	DAS units	Primary Participants	Data Years
M 16-17	Minor Teen	72	28	100	172	200
M 18-20	Adult Teen	72	28	100	172	200
M 21-25	Young Adult	72	28	100	172	200
M 26-35	Adult	72	28	100	172	200
M 36-50	Middle Adult	72	28	100	172	200
M 51-65	Mature Adult	72	28	100	172	200
M 66-75	Younger Older Driver	72	28	100	172	200
M 76+	Older Older Driver	72	28	100	172	200
F 16-17	Minor Teen	72	28	100	172	200
F 18-20	Adult Teen	72	28	100	172	200
F 21-25	Young Adult	72	28	100	172	200
F 26-35	Adult	72	28	100	172	200
F 36-50	Middle Adult	72	28	100	172	200
F 51-65	Mature Adult	72	28	100	172	200
F 66-75	Younger Older Driver	72	28	100	172	200
F 76+	Older Older Driver	72	28	100	172	200
Any	Advanced Vehicle Technology	0	350	350	350	700
<b>Totals:</b>		<b>1,152</b>	<b>798</b>	<b>1,950</b>	<b>3,102</b>	<b>3,900</b>

with nearly all other project tasks. Key issues include protection of participant confidentiality, protection of passengers who did not consent, protection of GPS location data, and continued protection of participant confidentiality once the data are stored in a database for post hoc analysis. Details of the IRB process and methods to ensure confidentiality are in the final report. The report also describes: how data will be transferred from vehicles to servers, including data encryption methods, data upload, processing, and backups; the data magnitude, which is expected to total approximately 1 petabyte; and methods for ensuring quality control, such as remote data health checks and contractor inspections.

#### Data Access

Data access policies address several concerns. The primary objective is to make the data as widely available as possible while maintaining the privacy assurances guaranteed in the consent form. The researchers plan to provide scalable user access control to the combined data sets. They expect that most external access to the data will be through a website or web service, but provisions will be in place to provide qualified users secure access to sensitive data. Data from the NDS will also be integrated with data from the roadway information database that will be developed in project S04A. Details regarding data access are in the final report.

This research was produced by the Virginia Tech Transportation Institute (VTTI) with the support of the University of Michigan Transportation Research Institute and the Battelle Memorial Institute. The Principal Investigator was Dr. Thomas Dingus of VTTI. The other authors of the report are Jon Antin, Suzanne Lee, and Jonathan Hankey of VTTI.

The Technical Coordinating Committee for Safety Research in SHRP 2 oversaw the conduct of the research that is the basis for this project brief. The committee membership includes **Forrest M. Council**, UNC Highway Safety Research Center; **David L. Banks**, Duke University; **James A. Bonneson**, Texas Transportation Institute (TTI); **Richard K. Deering**, RK Deering and Associates, Inc.; **Leanna Depue**, Missouri Department of Transportation; **Joanne L. Harbluk**, Transport Canada; **James H. Hedlund**, Highway Safety North; **Bruce A. Ibar-**

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#### Reference

1. *Special Report 260: Strategic Highway Research, Saving Lives, Reducing Congestion, Improving Quality of Life*. TRB, National Research Council, Washington, D.C., 2001. <http://onlinepubs.trb.org/Onlinepubs/sr/sr260.pdf>

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