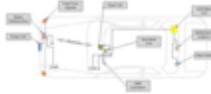


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Zoom: 31%

Naturalistic Driving Studies



- Instrument volunteer drivers vehicles and continuously collect data while they go about their normal activities. Why?...
 - What do drivers really do? Speeding, tailgating, cell phone, alcohol ...
 - What were they doing just before they crashed?
 - Usual crash studies we can only guess because we are surmising after the fact.
 - We can see fraction of second by second what happened.
 - What were other possible causal factors
 - How does the roadway, vehicle and environment impact driving?
- Several previous smaller naturalistic driving studies
 - 100-car: Northern Virginia, one year, 100 vehicle-years, 10 years old and still being used
- SHRP 2 Naturalistic Driving Study: 40 times larger
 - SHRP 2 data will be used for 20 years or more

2

CITRIX Talking: Jon Hankey

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NDS Example Data From InSight Website
(not an actual participant)



712039

3

CITRIX

Talking: Jon Hankey

The image shows a GoToWebinar Viewer window. At the top, the title bar reads "GoToWebinar Viewer" with standard window controls. Below the title bar is a "Zoom: 31%" dropdown menu. On the right side, there is a vertical toolbar with icons for back, microphone, and a blue square icon. The main content area displays a slide with the title "NDS Example Data From InSight Website (not an actual participant)". The slide features a 2x2 grid of images: top-left is a road view with a car and a number "712039" overlaid; top-right is a person in a white shirt; bottom-left is a car's interior; bottom-right is a road view. Below the grid is a small number "3". At the bottom of the viewer, the Citrix logo is on the left and "Talking: Jon Hankey" is on the right.

GoToWebinar Viewer

Zoom: 31%

SHRP2 NDS Study Design

- Largest Naturalistic Driving Study Ever Undertaken
 - 3,147 drivers, all age/gender groups.
 - 3,958 data years; 5 M trip files; 49.7 M vehicle miles
 - 3 years of data collection
 - Most participants 1 to 2 years
- Vehicle Types: All light vehicles
 - Passenger Cars
 - Minivans
 - SUVs
 - Pickup Trucks
- Six data collection sites
- Integration w/ detailed roadway information



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Durham, NC

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Naturalistic Driving Study Data Overview

- Driver demographics, assessments
- Vehicle descriptors
- Trip Data
 - Multiple Videos
 - Machine Vision
 - Lane Tracker
 - Accelerometer Data (3 axis)
 - Rate Sensors (3 axis)
 - GPS
 - Latitude, Longitude, Elevation, Time, Velocity
 - Forward Radar
 - X and Y positions
 - X and Y Velocities
 - Cell Phone Records
 - Beginning and end of all cell phone conversations on major carriers
 - Passive Alcohol Sensor
- Illuminance sensor
- Incident push button
 - Audio (only on incident push button)
- Turn signals
- Vehicle network data
 - Accelerator
 - Brake pedal activation
 - ABS
 - Gear position
 - Steering wheel angle
 - Speed
 - Horn
 - Seat Belt Information
 - Airbag deployment
 - Many more variables...

5

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Roadway (RID) Data Overview

- New data: collected at highway speed, about 12,500 centerline miles (both directions)
 - focus on data needed for lane departure and intersections
 - curvature location, length, radius; grade; cross-slope; lane number, width, type; shoulder type (width if paved); all MUTCD signs; medians; barriers; rumble strips; lighting; intersection location, number of approaches, and control type; videolog
- Existing data from ESRI and state inventory: any available roadway information – varies by site
- Supplemental data: traffic, weather; work zones; crashes; roadway improvements; laws

6

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SHRP 2 Naturalistic Driving Study and Roadway Information Databases Linked so that which 5M trips are driven on which roads are known

NDS Data

- 3,147 participants
- 3,958 vehicle-years
- 5 million trips
- Passenger cars, vans, SUVs, pickups
- Data recorded continuously on each trip

RID (GIS)

- New data collected
 - 12,500 centerline miles
 - Consistent across six sites
- Acquired data (DOTs, others)
 - 200,000 centerline miles
 - Roadway, Weather, Traffic

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NDS Data Characteristics

- Size: the dataset is huge
 - 2 petabytes
 - “Give me the whole raw data file” isn’t possible
- Complexity: different data types
 - Categorical data constant over a trip: driver age, vehicle type
 - Sampled data: collected at original resolution (once a trip up to 640 Hz during a crash): speed, acceleration, GPS position, radar, vehicle network information
 - Video data from 4 cameras
 - Automated reduction: lane tracker
 - Other automated techniques being funded now
 - Manual reduction: possible for other items for specific analyses
- Privacy considerations: personally-identifying data (PII)
 - Actual drivers being monitored during every time they are driving their vehicle

8

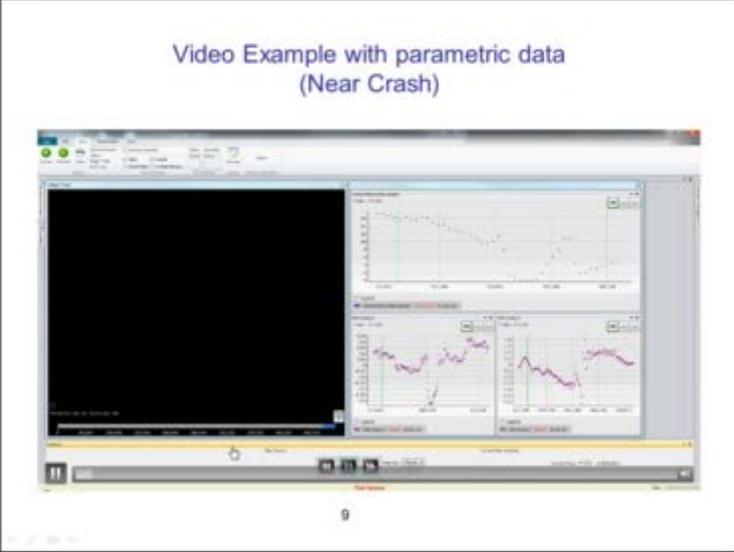
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2000 Terabytes

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Video Example with parametric data
(Near Crash)



The video player displays a presentation slide with the following content:

- Slide Title: Video Example with parametric data (Near Crash)
- Slide Content: A screenshot of a software interface. On the left is a video player with a black frame. On the right are three data charts: a line graph at the top and two bar charts below it.
- Slide Number: 9

CITRIX Talking: Jon Hankey

The image shows a screenshot of a GoToWebinar Viewer window. The window title is "GoToWebinar Viewer" and it has a zoom level of 31%. The main content is a slide with the following text:

Data Enhancements: How to Eat a Couple Petabyte Elephant

- **InSight** Website Data
 - Easily access to information chunks
 - Provides **InSight** into the data for researchers doing more **In-Depth** analyses
- Trip summary dataset
- **Crashes, near-crashes and baseline files**
- Linked NDS and RID data
- Reduced datasets designed for a research question topic areas (none planned currently but easily added)
 - Older and younger driver left turns at intersection
- Custom datasets for answering specific research questions
 - S08 contractors as examples

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Insight web site

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Crashes, Near-Crashes, Baseline Files

- Crashes: expect 700, varying severity
 - Most researchers want to examine crashes
- Near-crashes: "almost" crash but for sudden maneuver; 7,000
 - Crash surrogates; how did driver avoid a crash
- Baseline: randomly selected across all vehicles; 30,000
 - Denominator for risk calculations; measure overall prevalence
- Epoch files for each
 - 30-second data segments (20 before, 10 after; only 20 for baseline)
 - Includes most data
 - Manual eye-glance coding
- Event files for each
 - Categorical data coded from last 6 seconds of "before" data (driver distraction)
 - Manual video reduction; data dictionary on website

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InSight Website Data

- Data de-identified; no PII; fairly easy to access
- Drivers Assessments
- Vehicle information
- Trip Summary Data
- **Data from crashes, near-crashes, baseline**
 - Includes video and data viewer (under development)
 - Similar to Near Crash shown earlier
- Interface to the RID and NDS linking (under development)

12

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Example: Analyses Using Crash Data from Previous VTTI Studies

- From VTTI naturalistic driving studies
 - 100-car
 - Heavy truck
- Compare crash and near-crash risk of various distractions
- Use odds ratios: odds of a crash or near-crash with and without distracting activity
 - Odds above 1: increased risk
 - Odds below 1: reduced

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Non-Driving-Task Related Relative Crash/Near Crash Risk Estimates (Odds Ratio)

Task	Odds Ratio	Category
Passenger Interaction	0.5	Light Vehicle Data
Adjust Radio	0.6	Light Vehicle Data
Drinking	1.0	Light Vehicle Data
Talk/Listen Hand-Held	1.3	Light Vehicle Data
Eating	1.6	Light Vehicle Data
Handling CD	2.3	Light Vehicle Data
Dialing Hand-Held Device	2.8	Light Vehicle Data
Applying Make-Up	3.1	Light Vehicle Data
Reading	3.4	Light Vehicle Data
Talk/Listen to Hands Free Phone	0.4	Heavy Truck Data
Adjust Instrument Panel	1.3	Heavy Truck Data
Interact Occupant/s	0.4	Heavy Truck Data
Look Outside of Vehicle	0.5	Heavy Truck Data
Check Speedometer	0.3	Heavy Truck Driving-Related
Talk/Listen to CB	0.6	Heavy Truck Driving-Related
Reach for Object in Vehicle	3.1	Heavy Truck Driving-Related
Read Book, Paperwork, Newspaper, etc.	4.0	Heavy Truck Driving-Related
Personal Grooming	4.5	Heavy Truck Driving-Related

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SHRP 2 S08 Analysis Contracts

Each using a custom dataset to analyze InDepth

Phase 1: Proof-of-concept analysis

- 11 months, Feb. 2012 – Jan. 2013
- 4 awards
- 3 contractors selected for Phase 2

Phase 2: Full analysis

- Spring 2013 – July 2014
- 3 awards

Combined Phase 1 summary reports

Short version: <http://www.trb.org/Main/Blurbs/169021.aspx>
Longer version: <http://www.trb.org/Main/Blurbs/168727.aspx>

 **SHRP2** 15 **TRANSPORTATION RESEARCH BOARD**
STRATEGIC HIGHWAY RESEARCH PROGRAM OF THE NATIONAL ACADEMIES

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SAFER: Inattention-Risk Function for Lead Vehicle Crashes

- Research question:
 - How does driver inattention, as observed through measures of single glance (inopportune glance, single long glance) and glance history (intensity, duration), influence the risk of crash severity in Lead Vehicle Stopped, Lead Vehicle Decelerating, and Lead Vehicle Moving at Lower Constant Speed pre-crash scenarios?
- Applications:
 - Design or regulation of in-vehicle equipment requiring drivers to look away from the road

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Human Subjects Research

- Human subjects research is governed by international consensus and federal law
- The SHRP 2 NDS used human subject volunteers
- NDS data collection:
 - Oversight and approvals from Virginia Tech Institutional Review Board, NAS IRB, and 4 other IRBs
 - Approvals covered subject's knowledge of what is being collected; security of data collection, transmission, storage; protection from subpoena
 - "... you are consenting to other research uses ..."
 - Future research use of data for up to 30 years

 **SHRP2**
STRATEGIC HIGHWAY RESEARCH PROGRAM

20

TRANSPORTATION RESEARCH BOARD
OF THE NATIONAL ACADEMIES

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PII and InDepth Access

- Both identifying and non-identifying data collected
 - Personally identifying information (PII) is highly protected under federal law and the participant agreements (consent forms)
 - Includes face video, GPS traces, other items
- Non-identifying data can be more freely shared (e.g., InSight website)
 - Full access (qualified researcher) requires proof of IRB training
 - IRB training has several options; minimal time commitment; ensures degree of familiarity with human subject regulations

 SHRP2
STRATEGIC HIGHWAY RESEARCH PROGRAM

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TRANSPORTATION RESEARCH BOARD
OF THE NATIONAL ACADEMIES

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PII and InDepth Access

- For PII, other "qualified researchers" will be given access under data sharing agreement and IRB review/approval
 - At least the same level of security as provided for in CF
 - Face video de-identified if used for conference, media, education; no name or identifying location information with video
- PII must be viewed/coded in a secure data enclave
 - Under supervision
 - No copying or removing of PII
 - Enclave should be separate from other data reduction and analysis areas
 - Other hardware, software, and policy protections

 **SHRP2**
STRATEGIC HIGHWAY RESEARCH PROGRAM

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TRANSPORTATION RESEARCH BOARD
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InDepth Access Process

1. Explore InSight website
 - a. Take IRB training
 - b. Become a qualified researcher
 - c. Become familiar with variable and data dictionaries
2. Begin conversation with data steward
 - a. Scope and cost considerations
 - b. Feasibility of analysis and availability of appropriate data
3. Develop a detailed data specification in collaboration with data steward
4. Obtain IRB approval for the project from your home institution
 - a. In some cases the IRB will decide it is exempt (an IRB, not a PI, decision)

 **SHRP2**
STRATEGIC HIGHWAY RESEARCH PROGRAM

23

TRANSPORTATION RESEARCH BOARD
OF THE NATIONAL ACADEMIES

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InDepth Access Process

5. Work with data steward to develop a data sharing agreement (DSA)
 - a. Project description (with reference to data specification)
 - b. Project personnel
 - c. Proof of IRB training for each person
 - d. Proof of IRB approval or exemption
 - e. Agree to conditions protecting PII
 - f. Agree not to share the data with others (each InDepth analysis project requires separate IRB approval)
6. Work with data steward to:
 - a. Obtain specialized non-identifying dataset or
 - b. Schedule time in the secure data enclave

 **SHRP2**
STRATEGIC HIGHWAY RESEARCH PROGRAM

24

TRANSPORTATION RESEARCH BOARD
OF THE NATIONAL ACADEMIES

CITRIX

Talking: Jon Hankey

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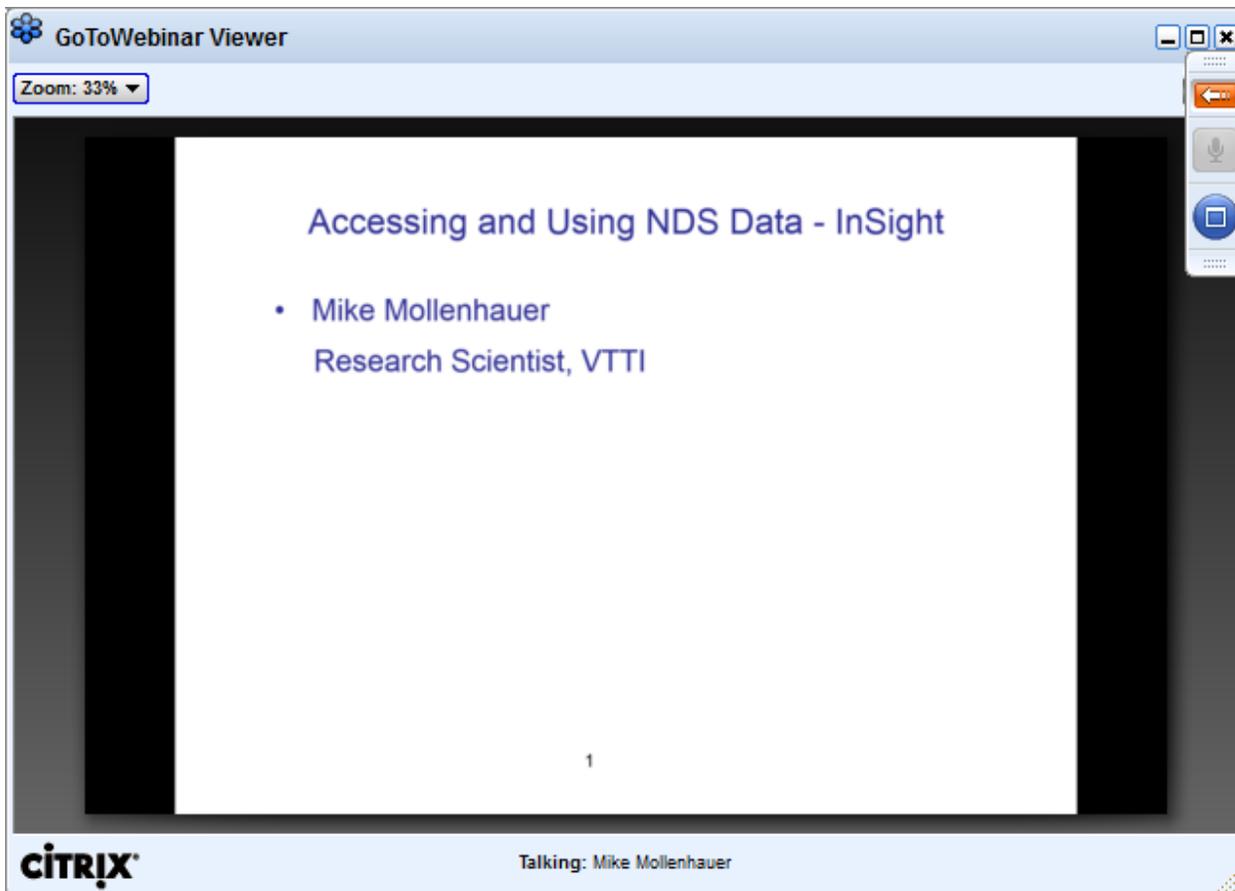
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Accessing and Using NDS Data - InSight

- Mike Mollenhauer
Research Scientist, VTTI

1

CITRIX Talking: Mike Mollenhauer



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Goals for the InSight Website

- Operate a public facing website to support data dissemination from the SHRP 2 naturalistic driving study (NDS) project
 - Background information about the SHRP 2 NDS method and program
 - Interact with SHRP 2 NDS data and data administrators
 - Explore and query collected data based on research criteria
 - A means to disseminate *some* data collected during the NDS

2

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Data Produced During the NDS

Participant Assessments

- Demographic Questionnaire
- Driving History
- Driving Knowledge
- Medical Conditions and Meds
- ADHD Screening
- Risk Perception
- Frequency of Risky Behavior
- Sensation Seeking Behavior
- Sleep Habits
- Visual, Physical, and Cognitive Test Results
- Exit Interview

Vehicle Information

- Make, Model, Year, Body Style
- Vehicle Condition
- Safety and Entertainment Systems

Continuous Data

- Face, Forward, Rear, and Instrument Panel Video
- Vehicle Network Data
- Accelerometers/Gyros, Forward RADAR, GPS
- Additional Sensor Data

Trip Summary Data

- Characterization of Trip Content
- Start Time and Duration of Trip
- Min, Max, Mean Sensor Data
- Time and Distance Driven at Various Speeds, Headways
- Vehicle Systems Usage

Event Data

- Crashes, Near Crashes, Baselines
- 30s Events With Classifications
- Post-Crash Interviews
- Other Crash Data

Cell Phone Records

- Subset of participant drivers
- Call time and duration
- Call type (text, call, pic, etc)

Roadway Data

- Matching trip GPS to roadway database
- Roadway classifications
- Other roadway data

3

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User Access Levels on InSight

```
graph TD; Guest[Guest User] -- "User registration" --> Registered[Registered User]; Registered -- "Apply for status" --> Qualified[Qualified Researcher];
```

Guest User

- Background information pages
- Data dictionaries and descriptions
- Aggregated data
- Sample data

User registration

- Email address, name, affiliation
- Agree to terms of use

Registered User

- Guest user access, plus...
- User forum access

Apply for status

- Complete IRB training (free online course)
- Upload training certificate

Qualified Researcher

- Registered user access, plus...
- Access to all dataset records
- Data query functionality
- Event viewing capability
- Customized data export (future)

4

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Example Use of Website

- A researcher wants to explore younger driver issues and has questions about how NDS data could be applied
- Some questions to consider
 - How many younger drivers participated?
 - How much data was collected from them?
 - What kinds of data are available through InSight? InDepth?
 - How many trips are available from younger drivers with higher sensation seeking tendencies?

6

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InSight Data Access Website
SHRP 2 Naturalistic Driving Study
[Learn More About SHRP2 NDS...](#)

Already Registered?
Username (email):
Password:
 Remember me [Forgot Password?](#)

Need an Account?
You must register to gain access to the available data.
[About User Access Levels](#)

What Is Available on This Website

- Information describing the 3,400+ drivers and vehicles that participated in the naturalistic driving study.
- SHRP 2 NDS status information including data collection and processing progress.
- Background information about the project and data being collected.
- 300,000+ Trip summary records that describe individual trips recorded during the study.
- 30,000+ Crash, near crash, and baseline driving events. (Coming Soon!)
- Discussion forums for questions about the project and available data.

What You Can Do on This Website

- View Background information about the SHRP 2 NDS.
- View detailed data collected from driver assessments, vehicles, trip summaries, and critical driving events.
- Query the database of detailed data, create cross tabulations, and assess NDS database content.

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Zoom: 33%

The screenshot shows a web browser window with the following content:

- Browser title: SHRP2 Data Access
- Page title: InSight SHRP 2 NDS
- Navigation tabs: Data, Forums, Background
- User profile: Michael Mollenhauer
- Banner: "Welcome to InSight" with subtext "InSight provides access to data collected during the SHRP 2 Naturalistic Driving Study (NDS)." over a background image of cars on a road at night.
- Section: "What's Available on This Website" with sub-sections:
 - Driver Descriptions and Assessments**: Summary graphs and detailed records of driver assessments are provided addressing driver demographic background, physical, psychological, and medical condition.
 - Summary of Continuous Naturalistic Data Collected**: Graphs and detailed records describe data collection progress and characteristics of trips collected during the study.
 - Vehicle Descriptions**: Summary graphs and detailed records describe the types of vehicles involved in the study.
 - Custom Query Capability**: Build custom queries to search for records matching criteria that span multiple datasets.
 - Naturalistic Driving Study Background Information**: Access an overview of the SHRP 2 naturalistic Driving Study project, data collection procedures, data dictionaries, and sample data.
 - Access to SHRP 2 NDS Forums**: Join a community of SHRP 2 NDS Forum members to discuss available data, website functionality, and related topics.
- Section: "What's New" with updates:
 - 9/10/2013 - New data released! New data include the Barkley's Quick Screen results and over 45,000 trip summaries.
 - 7/8/2013 - SHRP 2 InSight forum website is now available for technical support and general discussion.
 - 7/7/2013 - Query page expanded to include an initial cross-tab table configuration tool.
- Footer: "View More" link.

InSight
SRRP 2 NDS

Data Forums Background Michael Mollenhauer

Build a Query or Select a Data Category to View

Vehicles

View a collection of information about vehicles that were used to collect data in the SRRP 2 NDS.

- Vehicle types (car, truck, van, etc.)
- Vehicle ages and condition
- Amount of data collected per vehicle
- Quantities of vehicles installed
- Vehicle technologies and equipment

[View](#)

Trips

View a collection of information about trips collected and processed during the SRRP 2 NDS. Summary records can be used to screen for trips containing specific characteristics.

- Summary measures describing trips
- Trip length, duration, start time, stop time
- Min, Max, Mean for speed, acceleration
- Trip summary record table

[View](#)

Query Builder

Build and execute customized queries across multiple data tables, create cross tabulations, and view results.

- Select variables and conditions
- Submit query, assess results
- Build cross tabulations

[View](#)

Drivers

View a collection of information about drivers that participated in the SRRP 2 NDS.

- Quantities of drivers
- Amount of data collected per driver
- Driver demographics and driving history
- Driver physical and psychological state
- Driver participation experience

[View](#)

Crashes

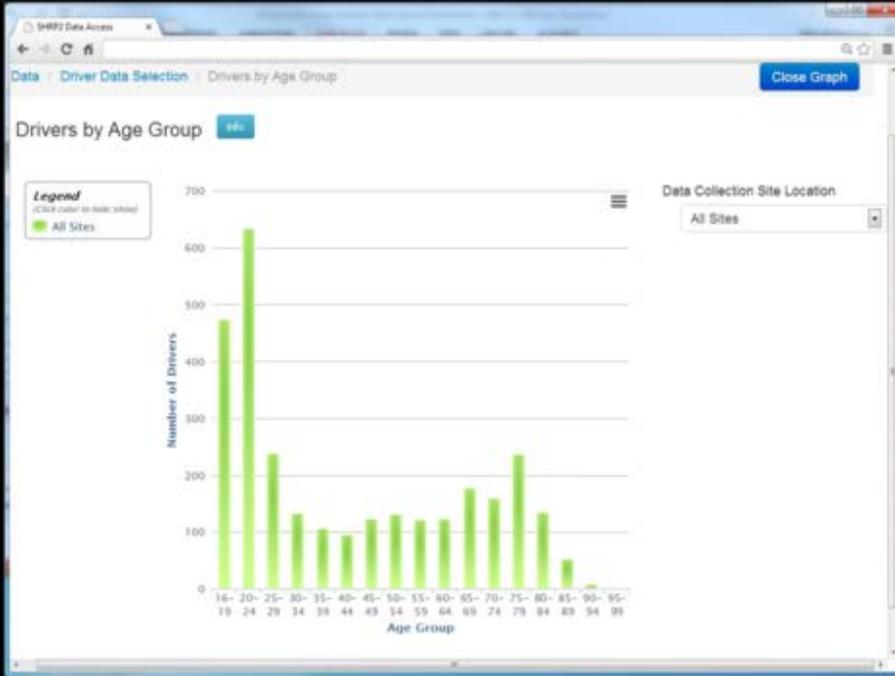
View a collection of information about crash, near crash, and baseline events captured during SRRP 2 NDS.

- Crashes by severity
- Detailed crash assessment records
- Crash event viewer

[View](#)

citrix.com/us/en-us/education/data/category/index

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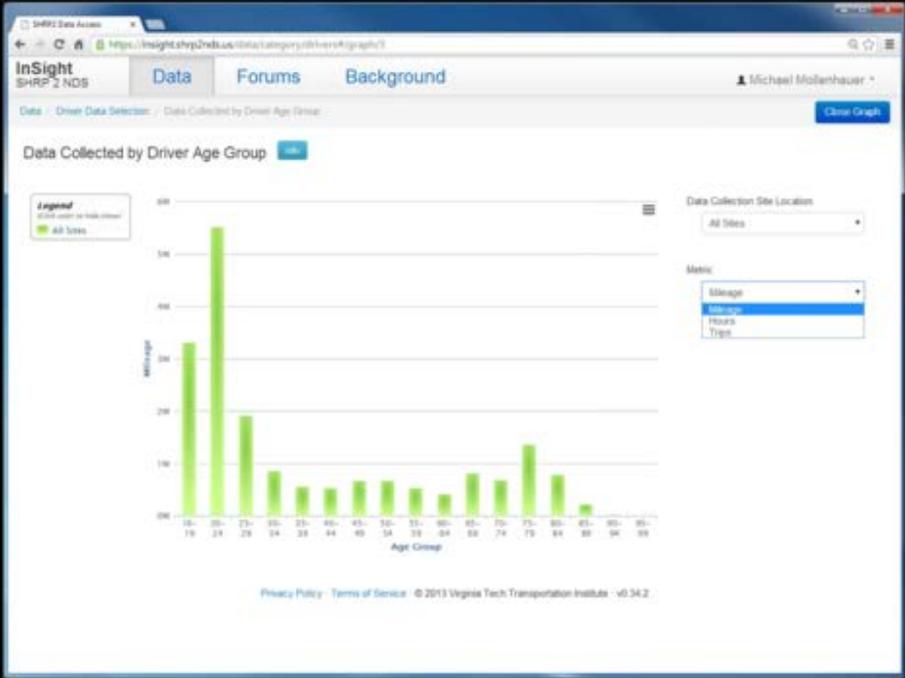


Zoom: 33%

The screenshot shows a web browser window with the URL <https://insight.shy2rds.us/data/category/drivers#list>. The page is titled "Driver Data Selection" and includes a search bar and several expandable sections. The sections are:

- How many drivers have participated in the study?
- How much data has been collected from drivers, processed, and made available on this website?
 - Data Collected by Driver Age Group (View Graph)
 - Data Collected by Driver Gender (View Graph)
- What are the demographic traits and driving history of participating drivers?
- What is the physical and psychological condition of participating drivers?
- What medical conditions and medications did driver report actually experiencing during the study?
- What was the driver's participation experience during the study?

Zoom: 33%



Talking: Mike Mollenhauer

Zoom: 33%

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 - Medical Conditions & Medications
 - Barkley's Quick Screen
 - Driving Knowledge
 - Perception of Risk
 - Risky Behavior
 - Sensation Seeking
 - JAMAR Hand Strength
 - Modified Manchester Driver Behavior
 - Driver Vision Testing Results
 - Sleep Questionnaire
 - Visual and Cognitive Testing Results
- What medical conditions and medications did driver report actually experiencing during the study?
- What was the driver's participation experience during the study?

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InSight
SHRP 2 NDS

Data Forums Background

Michael Mollenhauer

Data : Trip Data Selection

Trip Data Selection

Click ▼ to show, or ▲ to hide, additional information about each data item

Expand All Collapse All Reset

Search

▲ What are the characteristics of each trip collected and processed?

▼ Trip Summary Table View Table

▼ Time Series Data Dictionary

▼ How much data has been collected based on when the trip was started?

▼ How did maximum deceleration and speed vary by trip, vehicle classification, gender, and age group?

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Talking: Mike Mollenhauer

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The screenshot shows a web browser window with a dark theme. The main content is a white modal window titled "Trip Summary Table Data Dictionary Information". At the top of the modal, there are "Back", "Search", and "Printer Friendly Version" links, and a "Close" button. Below this, there is a section "About this Data" with links for "Background", "Protection of Personally Identifying Information", "Conversions", "Coordinates", and "Version History". The "Variables" section contains a table of data fields:

Variables		
Trip ID	Trip Start UTC Hour of Day	Trip Start UTC Month
Trip End UTC Hour of Day	Trip Start Local Time Hour of Day	Trip Start Month Local
Trip End Local Time Hour of Day	Trip Day of Week	Trip Day Number in Study
Trip Duration	Trip Distance	Trip Centroid Latitude
Trip Centroid Longitude	Trip Origin Altitude	Trip Destination Altitude
Max Speed	Mean Speed	Time Moving
Time Not Moving	Maximum Acceleration	Maximum Deceleration
Maximum Lateral Acceleration	Minimum Lateral Acceleration	Maximum Turn Rate
Minimum Turn Rate	Number of Longitudinal Accels > Threshold	Number of Longitudinal Decels > Threshold

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MP3 Data Access

InSight

Data Forums Background

Trip Summary Table Data Dictionary Information

Back Search Print Friendly Version Close

Number of Longitudinal Decels > Threshold Details

Variable Name:	Number of Longitudinal Decels > Threshold
Description:	Number of longitudinal decelerations > 0.4 g sustained for at least 1200 milliseconds
Variable Type:	Integer
Source:	n/a
Metric Units:	n
Standard Units:	n
Availability:	Accessible through InSight Website
Notes:	n/a

CITRIX Talking: Mike Mollenhauer

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Example (cont'd)

- It appears that there is considerable NDS data available from younger drivers
- Some additional questions to investigate:
 - How many drivers in the younger age groups had at least one trip or more with a large longitudinal deceleration? How many trips does that account for?
 - Did many of the younger drivers score higher on their sensation seeking assessment? How many trips are available from those that did?

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CITRIX Talking: Mike Mollenhauer

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Example (cont'd)

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CITRIX Talking: Mike Mollenhauer

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2015 and Beyond: Phased Approach

Phase 1: up to 5 years, begins 2015

- Test approaches to management, security, support, etc.
- Make data widely available, provide user support
 - General: website, help desk, documentation, tools
 - Individual: consultation, customized data, PII data access
 - Information: training, user groups, symposia
- New Oversight Committee of key stakeholders
- TRB continues to manage
- \$25 million available from SHRP 2 implementation funds
- Preparation for Phase 1 will continue throughout 2014

3

CITRIX Talking: Kenneth Campbell

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2015 and Beyond: Phased Approach

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Zoom: 26%

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- Preparation for Phase 1 will continue throughout 2014

3

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FHWA's Implementation Activities for the SHRP2
Safety Data

Monique R. Evans, PE
Director, Office of Safety Research & Development FHWA

- Safety Training and Analysis Center (STAC)
- Deployment
 - Implementation Assistance Program Solicitation
 - FHWA STAC Projects

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Safety Training and Analysis Center (STAC)

Why establish a STAC at TFHRC?

To accelerate and proliferate use of the data... to improve safety.



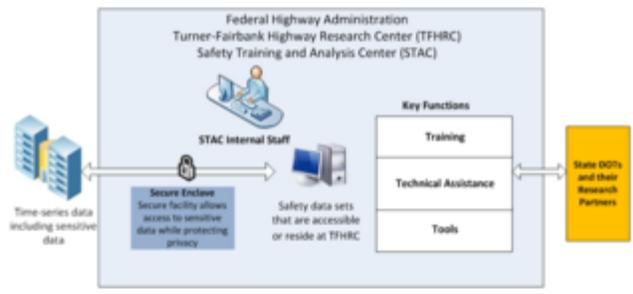
FHWA Turner-Fairbank Highway Research Center (TFHRC)

2

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Safety Training and Analysis Center (STAC)



4

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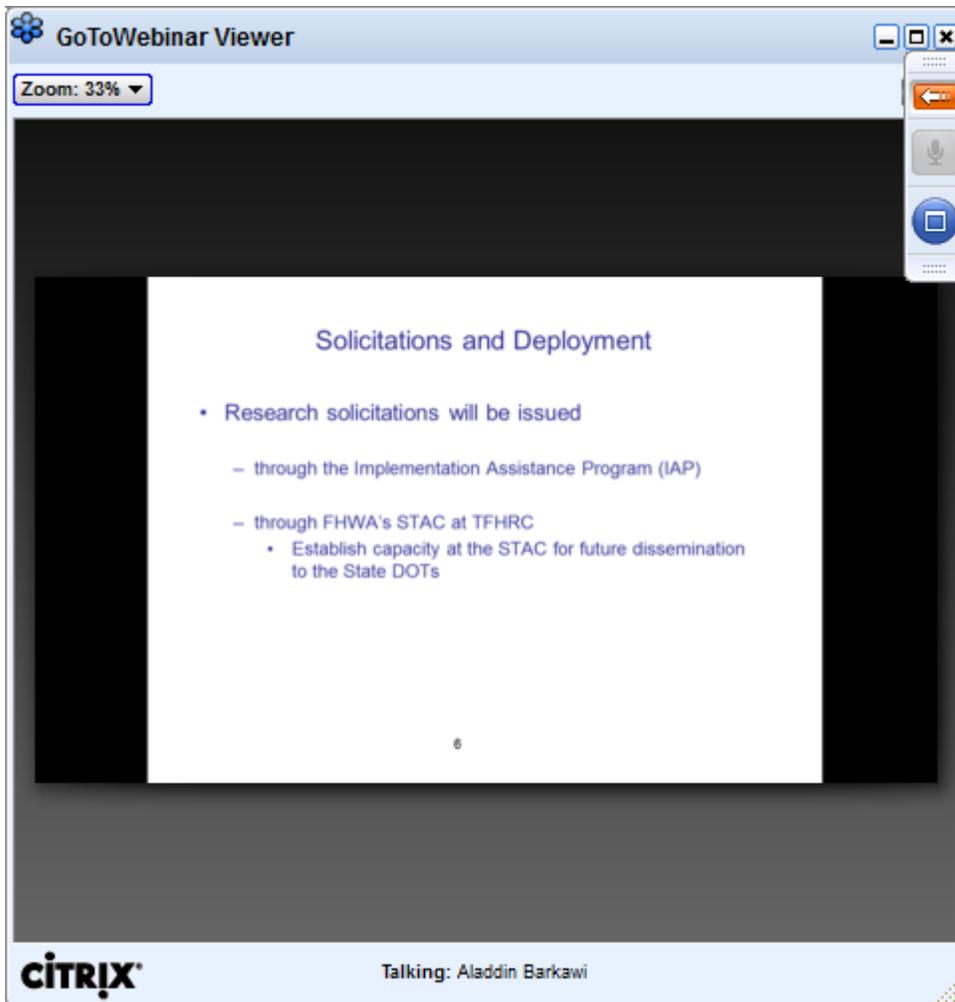
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Solicitations and Deployment

- Research solicitations will be issued
 - through the Implementation Assistance Program (IAP)
 - through FHWA's STAC at TFHRC
 - Establish capacity at the STAC for future dissemination to the State DOTs

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IAP Round 4 Timeline

Round 4 solicitation date (6/14) drives TF schedule

- Identify the number and type of research topics
- Application period mid-June to mid-July
- Team selections – end of August
- Defining and negotiating research details - Oct – Nov
- Research begins - December 2014

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 **TRANSPORTATION RESEARCH BOARD**
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 **SHRP 2 Naturalistic I**

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Virginia Tech (data) and Iowa State (roadway)

