2016 CCMTA ANNUAL MEETING
HALIFAX, NOVA SCOTIA

CONCURRENT SESSIONS

TOPIC:
UPDATE ON THE CANADIAN NATURALISTIC DRIVING STUDY (CNDS)

PRESENTER:
DR. CHARLIE KLAUER
RESEARCH SCIENTIST AND LEADER, TEEN RISK AND INJURY PREVENTION GROUP,
PRINCIPAL INVESTIGATOR AND PROJECT MANAGER, CANADA NATURALISTIC DRIVING STUDY,
VIRGINIA TECH TRANSPORTATION INSTITUTE
Canada Naturalistic Driving Study: Transportation Research Possibilities

Charlie Klauer, Ph.D.
Virginia Tech Transportation Institute

CCMTA, Halifax, Nova Scotia
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Outline of Presentation

- Power of Naturalistic Driving Studies
- Description of Canada NDS
- Videos
- Reduction process
- Results
- Next steps-Canada Insight/InDepth
- Description of the Canada Truck NDS
What are the advantages of Naturalistic Driving approach?

- More detailed driver behavior information in the seconds leading up to:
  - Incidents
  - Near crash
  - Crash

- Greater external validity
  - Information about driver behavior under normal day-to-day pressures

- Rich data set
  - Vehicle data
  - Driver data (demographic/questionnaire)
  - Video
Teen Driving Research at VTTI

- Naturalistic Teenage Driving Study (Complete)
  - 42 Teens, from licensure through first 18 months of driving

- Supervised Practice Driving Study (In Process)
  - 90 Teens, from Learners Permit through first 6 months of independent driving
  - Control Group

- Driver Coach Study (2012)
  - 90 Teens, from Learners Permit through first 6 months of independent driving
  - Feedback Group
Method

- Instrument 42 private vehicles with highly capable data collection systems
  - Collect continuous data beginning within 2 weeks of licensure and continuing for 18 months
    - 25 teens ‘own’ vehicle/17 teens share vehicle with parents
    - 50% male/50% female participants
  - Video, video snapshots, driving performance data, and questionnaire data
The percent of road segments where teenage drivers were speeding greater than 10 mph.
Engaging in Secondary Tasks by Month Since Licensure
### Secondary Task Engagement and CNC (Random Effects Logistic Regression)

<table>
<thead>
<tr>
<th>Secondary Task</th>
<th>OR</th>
<th>95% CI</th>
<th>OR</th>
<th>95% CI</th>
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</thead>
<tbody>
<tr>
<td>Phone - Texting</td>
<td>4.3</td>
<td>1.9/10.0</td>
<td>n/a</td>
<td>n/a</td>
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<tr>
<td>Phone - Dialing</td>
<td>7.8</td>
<td>2.7/23.1</td>
<td>2.5</td>
<td>1.4/4.5</td>
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<tr>
<td>Phone - Talking</td>
<td>0.8</td>
<td>0.4/1.5</td>
<td>0.7</td>
<td>0.5/1.1</td>
</tr>
<tr>
<td>Phone - Reaching</td>
<td>4.7</td>
<td>1.8/11.7</td>
<td>1.4</td>
<td>0.3/6.1</td>
</tr>
<tr>
<td>Object (not phone) - reaching</td>
<td>7.8</td>
<td>3.5/16.8</td>
<td>1.2</td>
<td>0.6/2.3</td>
</tr>
<tr>
<td>Roadside Object - looking</td>
<td>3.7</td>
<td>1.7/8.5</td>
<td>0.7</td>
<td>0.4/1.2</td>
</tr>
<tr>
<td>Radio/HVAC – managing</td>
<td>1.4</td>
<td>0.8/2.7</td>
<td>0.5</td>
<td>0.3/0.9</td>
</tr>
<tr>
<td>Vehicle Operations - performing</td>
<td>2.5</td>
<td>0.9/7.3</td>
<td>0.6</td>
<td>0.2/2.7</td>
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<tr>
<td>Eating</td>
<td>3.3</td>
<td>1.5/7.2</td>
<td>1.3</td>
<td>0.7/2.1</td>
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<tr>
<td>Drinking (non-alcoholic)</td>
<td>1.3</td>
<td>0.3/5.7</td>
<td>0.4</td>
<td>0.2/1.2</td>
</tr>
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</table>
NTDS Study Publications


Canada Naturalistic Driving Study

Data collection site:
Saskatoon, Saskatchewan
CNDS Primary Research Questions

- What is the distribution of causal/contributing factors to crashes and near-crashes in Saskatchewan, Canada?
  - Rural highways
  - Winter conditions

- What is the prevalence of risky behaviors?
  - Of primary interest is speeding (per speed limit but also per roadway conditions), secondary task engagement, drowsiness, and impairment.
CNDS Study Data collection

- 140 vehicles were instrumented
- Targeted 125 participants/Replaced some participants.
  - Participants were recruited for 24 months, 18 months, or 12 months
  - Data collection occurred from 6/2013-10/2015
- Recruited participants through SGI
  - SGI sent letters to target the population of interest
  - Participants were paid $450 per year
**Light Vehicle Recruitment**

### Target Participant Numbers

<table>
<thead>
<tr>
<th></th>
<th>Age 18-25</th>
<th>Age 26-65</th>
<th>Age 66+</th>
</tr>
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<tbody>
<tr>
<td>Male</td>
<td></td>
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<tr>
<td>Female</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>High Mileage Commuter</td>
<td>9-10</td>
<td>9-10</td>
<td>12-16</td>
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<tr>
<td>Low Mileage Commuter</td>
<td>7-9</td>
<td>6-9</td>
<td>12-15</td>
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### Study Participant Numbers

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<tr>
<td>Female</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>High Mileage Commuter</td>
<td>3</td>
<td>8</td>
<td>17</td>
</tr>
<tr>
<td>Low Mileage Commuter</td>
<td>21</td>
<td>18</td>
<td>15</td>
</tr>
</tbody>
</table>
Data Acquisition System

- Multiple Videos
  - Machine Vision Eyes Forward Monitor
  - Machine Vision Lane Tracker
- Accelerometer Data (3 axis)
- Rate Sensors (3 axis)
- GPS
  - Latitude, Longitude, Elevation, Time, Velocity
- Forward Radar
  - X and Y positions
  - Xdot and Ydot Velocities
- Cell Phone
  - ACN, health checks, location notification
  - Health checks, remote upgrades
- Illuminance sensor
- Passive alcohol sensor
- Incident push button
- Video
- Audio (only on incident push button)
- Turn signals
- Vehicle network data
  - Accelerator
  - Brake pedal activation
  - ABS
  - Gear position
  - Steering wheel angle
  - Speed
  - Seat Belt Information
  - Airbag deployment
  - etc
NextGen Data Acquisition System
DAS Photos

Main Unit

Front Radar Assembly

Head Unit
Camera Image Samples

- Forward View - color
  - 15 Hz continuous video
  - 640x320 pixels

- Driver Face – Rotated for max pixel efficiency

- Right-Rear View

- Center stack – Pedal Interactions

- Periodic still cabin image, permanently blurred for passenger anonymity
Canada NDS Study Status

- Data collection is complete
- Crash/near-crash and Baseline control segments have been coded
  - Eyeglance coding complete on CNC
  - Eyeglance coding is in process for Baseline control segments
- Working on preparing data for data sharing website
General Study Stats: Preliminary Results

- 83 crashes and 301 near-crashes
- 1,904,813 vehicle kilometers traveled
- 53,718 vehicle hours traveled
CNDS Data Reduction Effort
Data Reduction (similar to SHRP 2 NDS)

- Driver ID by trip
- Crash/Near-Crash identification
- Crash/Near-Crash coding
  - Eyeglance
- Baseline coding
  - Eyeglance
Driver ID by Trip

- In-house developed software
- Takes snapshots from face video at beginning and end of trip.
- Trained coder records driver id.
- SHRP2 NDS could code up to 800 trips per hour
- Non-consented drivers excluded from database
CNC Process: Development of CNDS
“Event” Database

- Events are identified based on “trigger” signatures from the electronic data that are indicative of the presence of a crash, near crash or conflict/incident event.

- Triggers include:
  - Radar-based time-to-collision
  - High lateral acceleration or yaw-rate change
  - Unplanned lane deviation
  - High longitudinal decelerations
  - High longitudinal decelerations with short time to collisions
  - Driver reported crashes
Event Variables

- Pre-Incident maneuver
- Crash/Incident type
- Precipitating factor
- Contributing factor(s)
- Evasive maneuver
- Roadway/Traffic variables
- Weather/Lighting
- Driver’s state
  - Eye glance location
  - Observer rating of drowsiness
- Fault assignment
- Crash reconstruction
- Manual eyeglance for 20 seconds plus 10 s
Baseline Variables

- Roadway/Traffic variables
- Weather/Lighting
- Driver’s state
  - Eye glance location
  - Observer rating of drowsiness
- Manual eyeglance for 20 seconds
Preliminary Results from Canada NDS
Vehicle Description of Canada NDS
Ages of Primary Participants
Types of Crash/Near-Crash in Canada NDS

- Other (leave a note)
- Conflict with merging or weaving vehicle
- Conflict with pedestrian
- Conflict with a following vehicle
- Conflict with obstacle/object
- Conflict with oncoming traffic
- Conflict with parked vehicle
- Conflict with vehicle into path
- Conflict with vehicle across path
- Conflict with animal
- Conflict with vehicle in adjacent lane
- Single vehicle conflict
- Conflict with a lead vehicle
Type of Road Surface Condition for Crashes and Near-Crashes
Next Steps

- **Driver Behavior**
  - Secondary task engagement
  - Drowsiness
  - Impairment
  - Other Risky Behavior

- **Infrastructure**
  - Many intersection crashes
  - Snowy/icy conditions

- **More NDS Data collection??**
  - 140 data acquisition systems are in storage in Canada
Canada NDS Website

Description of SHRP2 InSight Website
Goals for the InSight Website

- Operate a public facing website to support data dissemination from the Canada naturalistic driving study (CNDS) project
  - Background information about the CNDS method and program
  - Interact with CNDS data and data administrators
  - Explore and query collected data based on research criteria
  - Interact with CNDS and SHPR2 NDS data…
  - Differentiate between InSight Data analysis or InDepth data analysis (data sharing agreement).
What Can Users Do With the InSight Website?

- Review data collection procedures and project background
  How was this data collected?
- Explore data inventory, data dictionaries, and download sample data
  What variables are collected and how are they defined?
- Query for how many drivers, vehicles, or trips exist in the database that match various research criteria
  How much data is available that matches my research criteria?
- Review crash, near crash, and baseline events identified and classified during the study
  What were the details and context of the event?
SHPR2 NDS InSight Website:
https://insight.shrp2nds.us/
Welcome to InSight

InSight provides access to data collected during the SHRP 2 Naturalistic Driving Study (NDS).

What's Available on This Website

**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.

What's New

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 crosstab table configuration tool.

View More...
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 SHRP 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

**Trips**
View a collection of information about trips collected and processed during the SHRP 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

**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

**Drivers**
View a collection of information about drivers that participated in the SHRP 2 NDS.
- Quantities of drivers
- Amount of data collected per driver
- Driver demographics and driving history
- Driver physical and psychological state
- Driver participation experience

**Crashes**
View a collection of information about crash, near crash, and baseline events captured during SHRP 2 NDS.
- Crashes by severity
- Detailed crash assessment records
- Crash event viewer
Driver Data Selection

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

- How many drivers have participated in the study?
  - Drivers by Age Group
  - Drivers by Age Group and Gender
  - Drivers Active and Completed

- How much data has been collected from drivers, processed, and made available on this website?
- 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?
Accessing the NDS Data: Why we need Data Use Licensing

- Promises were made to participants and to the Research Ethics Board and Institutional Review Board overseeing the data collection
  - Additional use of data is subject to REB/IRB approval
  - Additional use of original data (whether identifying or not) requires a data use license
  - Identifying data (PII) can only be used in a secure data enclave
  - Only de-identified summary data can be readily shared
    - But this term is still not fully defined or vetted
- All original data must eventually be deleted so usage must be tracked
Website Users

- Some original data can be viewed and queried from the website (cannot be downloaded because of tracking requirement)
- Need some minimal qualifications for users of original data on website
  - Proof of training in human subjects protection (REB training certificate, IRB training certificate)
- Users can only view background information about the study
- Qualified researchers can view and query all data available on the website
  - Have submitted a training certificate
Other Data Users

- Those who want to hold a subset of the data locally or come to the secure data enclave to work with PII must submit a data use license application
  - Includes Purpose, Scope, and Data Specification (exactly which subset of the data do you need?)
  - Requires proof of REB/IRB approval (or proof of exemption)
  - Requires a data security plan (to ensure data will be held at the level of security promised to participants)
  - If there is a cost associated with extracting the data, the contract must be executed prior to the DUL (DUL is a license to use the data, does not mention money)
Common Misunderstandings

- REB/IRB training certificate is proof of REB/IRB approval for a project
  - REB/IRB training certificates are issued to individuals upon completion of a course and do not confer approval for specific research projects
  - REB/IRB approval or proof of exemption is granted to a project (typically involving a group of researchers)
- Training certificate – issued to individual, used to become Qualified Researcher
- REB/IRB approval – issued to project, used to obtain data use license
- Data use license – agreement between institutions, not individuals (if a researcher moves to a new institution, they will need a new DUL to continue working with the data)
Canada Naturalistic Truck Driving Study

Charlie Klauer, VTTI
**Project Status**

- 25 trucks completed data collection
  - 25 participants (3 teams)
  - 2 females
  - 5 trucks with long routes (7-10 days on and 3-4 days off)
  - 2-3 double-trailer drivers

- Two minor crashes known to-date.
Procedure

- Collect questionnaire/assessments on drivers
  - Based upon other commercial NDS studies
  - Driver logs
  - Driver abstracts

- Instrumented 25 trucks (with reinstrumentations)
  - Similar DAS as light vehicle study with cameras, radar, accelerometers, etc.

- Collect data for ~12 months = ~22 data years.
Questions, Additions, or Concerns?
CNDS Strengths

- Better view for distraction
  - Center stack
  - Driver

- Drowsiness coding

- Weather

- Cars and Heavy Trucks

- It is in Canada and Unique

- Roadway data???

- Possible enhancements to build strength
  - More detailed fatigue assessment could be added (obtain separate funding)
  - Canada specific baseline
The Canada NDS was funded by the Council of Deputy Ministers Responsible for Transportation and Highway Safety and CCMTA

Questions???