

# The Canada Naturalistic Truck Driving Study

The primary goals of the Canada Naturalistic Truck Driving Study (CNTDS) are to gain a greater understanding of the driver behaviour associated with crash occurrence, as well as how heavy vehicle operators interact with and adapt to the vehicle, roadway, traffic environment, weather, etc. Additionally, the data collected during the CNTDS can be used to better understand the impact of roadway design and infrastructure on driver behaviour and crash/near-crash occurrence. The CNTDS was conducted as an extension of the Canada Naturalistic Driving Study (CNDS). For more information about CNDS please visit the following link: [https://insight.canada-nds.net/documents/cnds\\_background.pdf](https://insight.canada-nds.net/documents/cnds_background.pdf)

The power of naturalistic driving studies lies within the data made available by the continuous video collected during real-world driving situations. During the CNTDS, in-vehicle cameras recorded views of the driver's face, over the driver's shoulder, and both the forward and rear roadways in order to understand how driver behaviour may contribute to or neutralize the impact of a conflict both before and during a safety critical event (e.g., crash). A broader understanding of driver behaviour during these events will improve the ability to design vehicle safety systems that provide the most effective crash countermeasures.

The study includes 22 heavy truck drivers from Saskatoon, Saskatchewan and the surrounding areas. Consented participants in each area completed questionnaires at the beginning of the study, had similar data acquisition systems (DASs) installed in their personal vehicles, and completed similar questionnaires at the end of the study. Data were collected for approximately 12 months.

## Participant Recruitment

All 22 participants were recruited from the city of Saskatoon in the Canadian province of Saskatchewan. Data were collected between November 2014 and March 2016. The majority of participants were recruited by working with participating trucking companies. Safety managers at the trucking companies assisted us in recruiting drivers who did not cross international borders. Any interested persons were asked to contact the CNDS office via a phone number provided in the recruitment material or to visit the CNDS website for further information about the study and to complete the initial screening forms. Eligible participants were then contacted by trained researchers to schedule a time at the CNDS office for completion of study participation consent forms, initial questionnaires, and to have their commercial motor vehicle instrumented with the DAS.

## Data Collection Procedures

Participants were recruited to participate in this research effort for approximately 12 months. Participants were paid \$750 per 12-month period of data collection. At the end of the study, researchers had recruited and collected data on 22 participants and collected over 15,000 vehicle hours travelled.

## Consent procedure:

All eligible participants who were of appropriate age, held a valid Class1 driver's licence, and had a suitable vehicle were accepted as study participants. Each participant signed an informed consent to participate in the study, per both Canadian Research Ethics Board and U.S. Institutional Review Board standards. All participants also agreed to have a DAS installed in their commercial motor vehicle for the duration of the study.

Surveys, questionnaires and interviews:

Each participant also completed a battery of questionnaires and surveys that assessed driving knowledge and habits, health and sleep hygiene, and some personality factors. Many of these questionnaires and surveys were available on-line, and could have been completed either at the participant's home or at the CNTDS study office. Completion of all assessments took approximately 1 to 2 hours.

### Data Acquisition System (DAS)

The DAS that was used for the CNDS was similar to the system that was used for the SHRP 2 NDS and several USDOT funded commercial motor vehicle naturalistic driving studies. This system was designed and developed by the Virginia Tech Transportation Institute (VTTI). The DAS includes five continuous video channels, including a colour forward view camera, driver's face, over-the-shoulder, and left side of vehicle and right side of vehicle cameras. The DAS also includes forward radar, multi-axis accelerometers, a machine vision-based lane tracker, GPS data, and a connection to J1708, J1939 or J1939 Type 2 CAN bus data, depending upon make/model/year of semi-cab, to collect vehicle speed, brake (on/off), and throttle position. The complete list of sensors is shown in Figure 1. The driver's face camera and forward view cameras are located in the head unit, which is installed directly behind and slightly below the rear-view mirror (Figure 2). The accelerometers and passive alcohol sensor are also located in the head unit.

Data Acquisition System Channels		
◆ Multiple videos	◆ Cell phone	◆ Vehicle network data
◆ Machine vision	– Automatic collision notification, health checks, location notification	– Accelerator
– Eyes forward monitor	– Health checks, remote upgrades	– Brake pedal activation
– Lane tracker	◆ Illuminance sensor	– Automatic braking system
◆ Accelerometer data (3 axis)	◆ Infrared illumination	– Gear position
◆ Rate sensors (3 axis)	◆ Passive alcohol sensor	– Steering wheel angle
◆ GPS: latitude, longitude, elevation, time, velocity	◆ Incident push button—audio (only on incident push button)	– Speed
◆ Forward radar	◆ Turn signals	– Horn
– X and Y positions		– Seat belt information
– X and Y velocities		– Airbag deployment
		– Many more variables

Figure 1. Complete list of sensors in the DAS.



Figure 2. Picture of head unit installed behind rear-view mirror.



Figure 3. Picture of the main DAS unit which was installed either in sleeper compartment or under passenger-side front seat.

The hard drive is located in the DAS main unit (Figure 3). Rear-facing cameras are located on the side-view mirrors and cellular antenna are installed on the windshield. The cellular capability is critical to controlling the quality of the data, as it both provides “health checks” to VTTI and allows software updates to be broadly deployed to the instrumented vehicles.

The camera images are combined into a four-framed image as shown in Figure 4. The colour forward view is located in the upper left quadrant; the driver’s face is in the upper right quadrant; the over-the-shoulder view is in the lower right quadrant; and the rear view is in the lower left quadrant.



Figure 4. Quad image of driver face (upper left), colour forward view (upper right), over-the-shoulder (lower left), and rear view (lower right).

For additional information regarding participants, vehicles, trips or events, the reader is encouraged to view the Data tab on <https://insight.canadatruck-nds.net/>