Naturalistic Driving
DaCoTA – wp6
Data Collection Transfer and Analysis
Transport Research Arena

Athens April 25th, 2012
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Contents

• What do we need? Methods
• Naturalistic Driving – Research and Monitoring Scale and technology
• DaCoTA wp6 - Driver Behaviour Monitoring through Naturalistic Driving Observations
Methods

- Disadvantages of many methods:
  - Retrospective, when it already happened
  - In an un-natural environment
  - Self reported behaviour

- How do we really drive?
  - Not influenced
  - ‘Being present’ as a researcher

- ICT ‘break through’
  - Sensors
  - Camera’s
  - Data-storage (including video)
  - Data-mining
Typical instrumentation

- Car Sensor
- Car Sensor
- Extra Sensor
- Extra Sensor
- Extra Sensor

Data Acquisition System (DAS)

Storage Device
Naturalistic Driving

• (Automated) Observational method
• Natural (driving) behaviour of the participant is observed, in their natural environment
• Uncontrolled
• Huge amount of information → linked indicators

• Compare groups (odds ratio) or Case-crossover design (within)
Monitoring versus Research

- Research ("why is it happening") is intended to determine increased risk of a certain behaviour comparable to Blomberg curve on alcohol

- Monitoring ("what is happening") intends to describe the prevalence of certain behaviour, such as
  - the percentage of kilometres driven with a BAC level above 0,5‰ or above 1,3 ‰, by day of week and age of driver
  - the percentage of trips in which excessive speeding occurs, by age & gender of driver

Figure 2. Crash rates for various BAC levels (Blomberg et al., 2005)
To Study

• Large scale road safety monitoring
  basic vehicle measures without any video is sufficient

• Crash risk and crash causation
  trigger based recording would be valuable

• Distraction and inattention
  continuous video data is required

• Vulnerable road users
  continuous video data is required and additional data desired

• Vehicle and its usage
  continuous video data is required

• Road design
  continuous video data is required and data enrichment is desired
Continuous basic measures

FOT-Net 4th International Workshop, Orlando
Continuous basic measures

FOT-Net 4th International Workshop, Orlando

Sample size

Small
<100 vehicle years

Medium
>100 vehicle years

Large
>1,000 veh. years

Extra large
>10,000 veh. years

Data collection technology

Additional measures or data sources
(site based observations, data enrichment)

Continuous advanced measures (incl. video)

Trigger based measures incl. video

Continuous basic measures

Vulnerable Road Users

Distraction & fatigue

Road design

Vehicle and ITS usage

Crash risk & causation

Distraction & fatigue

Monitoring

Use existing data

Priority for future study!

Vulnerable Road Users

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WP6 - Driver Behaviour Monitoring through Naturalistic Driving Observations

We want
- better data, more data
- more efficient data collection
- better comparability

To
- better analysis, measures, policy

Tasks
1. Definition of Naturalistic Driving observations within ERSO
2. Study Design
3. Small Scale practical study
4. Implementation plan for Large Scale Naturalistic Driving research within ERSO

Timing: task 1 is finished, tasks 2 and 3 drafts finalised by May 2012, task 4 in November 2012
6.1 Monitor normal driving behaviour

Representative sample of drivers / vehicles
unobtrusive, simultaneous measurement

- Risk exposure data (RED)
  - vehicle type (model, year, …)
  - driver type (age, gender, experience, …)
  - trip variables (day, hour, road type, duration, …)
  - map match (GPS locations)

- Safety Performance Indicators (SPI)
  - descriptive (speed)
  - speeding, DRL, protective systems, headway, lane behaviour

- Incidences
  - near crashes, critical situations, successful avoidance?
Near Crashes in DaCoTA

- Full video or triggered video is too costly
  - Only triggers from vehicle parameters
  - Certain types go undetected, because no vehicle reaction is present
  - No verification, high level of trigger values can minimise false positives
  → count of events (+ situation and background of vehicle & driver)

- National: having a set of ND vehicles, equip a subset with additional devices (video) to verify and detect other types of near crashes
Task 6.2 - Study Design

- Small scale design
  - Analysis plan, derive indicators (SPI, RED, NC) from the data by algorithm.
  - Data gathering, reduction, retrieval, cleaning, storage (secured)
  - Database development
  - Ethical issues

- The Study design will use results of the pilots
  - Sampling and weighing, maintenance of the sample
Task 6.2 - Ethical issues

• Liability
  – Mounting DAS may not have any consequences

• Privacy
  – Data protection in the vehicle, during transfer, database storage
  – Insurance when DAS or complete car stolen

• Legal
  – Ownership of data: in case of an incident, authorities may not use ND data as proof

→ informed consent, insurance, procedures

Other drivers, passengers, sound, video, also persons outside the vehicle
Participant selection

- **Sample size**
  - How big is inter-human & inter-vehicle variation?
  - How big is the trip variation of the same participant?

- **Country comparisons**
  - Equal number or % of drivers?

- **Representative sample**
  - No requirements on age of driver, vehicle

- **Selection bias**
  - Ethical issues
  - Annual kilometres

- **Sample maintenance (participants grow older)**
Data

- Terabytes of data
- Time line; different devices may have different sample frequencies – synchronisation
- Finding an event in the data
- Response times
Focusing on speed SPI

For Safetynet
- Data on instantaneous speed of vehicles at a point
- A sampling procedure to select a restricted set of locations representative of the network
- Choice of observation period
- Measure of speed in reasonably free flowing traffic conditions
- Specific speed indicators
- Indicators disaggregation by road type, speed limit, vehicle type, period of day and period of the week

For NDO
- Speed variations during the trip of a driver
- A sampling procedure to select a restricted set of drivers representative of the population
- Choice of observation period
- Filtering of the vehicle speed to keep only free flowing conditions
- Specific speed indicators
- Indicators disaggregation by road type, speed limit, driver type, period of day and period of the week
Illustration: ND Data linked to speed

ND Data measured during a specific trip

Over speeding

free flowing traffic

legal speed limit

Traffic congestion

Urban road

Motorway

Time of the trip

25-04-2012
Task 6.3 Small scale Pilots

- Feasibility of data gathering, practical and technical
- 2 small scale studies (Austria and Israel)
  - Variables, equipment, ethical issues
  - Each country, 10 car drivers * 6 months

Collection of
- Data on speed behaviour, daytime running lights, seatbelt usage, lane keeping, headway
- Data-logbook of drivers' identification (-10%), trip duration, length, timing, location, stratify road types and vehicle types
- Certain manoeuvres/parameters as proxy for near crashes

- Additional data collection UK
  - Mobile phone
Methods for data-gathering

Data acquisition system

• Austria
  • pdrive system®
  • pdrive light

• Israel
  • Greenbox & Mobileye, using TrackTec
  • Various car makes and models

• UK
  • analysis of AT video data
  • smartphone with GPS
Austria: trips over the day by gender
Austria: speed per road type/sex

(Area-Of-Focus (AOF) charts showing speed distribution for Motorway, Outside urban area, and Urban area for male and female individuals.)

25-04-2012 TRA2012 Athens
# Israel: general results

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<tr>
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<th>Time-Based Measurement</th>
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<tr>
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<td>180,499</td>
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<td>Cut off Warning</td>
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<td>Headway warning</td>
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<td>Night and Dusk Indication</td>
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<tr>
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<td>14,324</td>
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<tr>
<td>Light warning</td>
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<td>2,136</td>
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<tr>
<td>Total</td>
<td></td>
<td>283,490</td>
</tr>
</tbody>
</table>

25-04-2012

TRA2012 Athens
Israel: headway distribution

- Less than 0.5 sec: 6%
- 0.5-1 sec: 9%
- 1-1.5 sec: 16%
- 1.5-2 sec: 13%
- 2-2.5 sec: 9%
- 2.5 and up sec: 47%

25-04-2012
TRA2012 Athens
Differences and “Added value”

• Unique to DaCoTA / ND
  • Continuity of data gathering
  • Scale, representative and comparable
  • Simultaneous measurement
  • Focus on SPIs and Mobility
  • Risky behaviours occur in normal driving
  • Map-matching possible
  • Processing of data into useful safety indicators
Summary

- ERSO = data driven knowledge on road safety in EU
- DaCoTA = use and enhance ERSO
- WP6 = feasibility to fill ERSO with indicators derived from Naturalistic Driving: RED, SPI, NC
  - Monitoring ↔ Research
  - Limited set of near crashes by vehicle triggers
  - Large scale, continuous monitoring, prevalence of risky behaviour
- Technically it is feasible; profit ↔ investment
- Follow up after 2012?
Thank you for your attention

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