Truck Drivers' Behaviors and Rational Driving Assistance

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Project Organization

Field of research: Human behaviors during truck driving activity in real and/or simulated situations

Three main parts:

- 3 studies about economical and psycho-sociological factors in relation to rational driving and truck driver's job (*separately report*)
- A Ph D thesis in cognitive psychology about modeling truck drivers' behaviors in relation to a rational driving
- A Master of research in cognitive psychology to assess a new HMI: an haptic accelerator pedal (*separately report*)
Goal of Renault Trucks' Advanced Engineering

- To develop an adaptive eco-driving assistance system in order to help the driver to optimise his fuel consumption according to the best strategy
  - Taking into account and integrating, in real time, driving styles, drivers' behavioural variability and data coming from the road environment through the Electronic Control Unit
- To design a new HMI based on force feed-back in accelerator pedal
"Research about interactions between technical progress and human behaviors with the idea of sustainable development: about the economical driving assistance of a truck"

- Focus on economical, psychological and cognitive aspects of truck drivers' behaviors in order to a rational driving
- Systemic approach of truck driving activity with the driver in the heart of the system Driver/Vehicle/Environment
- Pluri-disciplinary approach: Human Science are applied to Advanced Engineering from a behavioral point of view
- Multi dimensional methodology
Systemic Approach

- ENVIRONMENT
- DRIVER
- H.M.I.: Human Machine Interface
- VEHICLE
- ASSISTANCE

Action
Information
Goal of Thesis Researches

Providing Renault Trucks with a correct truck drivers' behavior model in relation to a rational driving

- Translation of driving behaviors into objective and measurable criteria
- Identification of bad behaviors that an assistance system can correct in order to decrease fuel consumption
- Designing behavioural models according to personality, cognitive and driving styles
- Validation of a workload index for truck driving activity
Rational Driving

Optimisation of the global vehicle productivity:

- Optimisation of drivers' fuel consumption
- Optimisation of the use of the drive line components (braking, gear changes, use of engine speed, etc.)
- Optimisation of the ratio "delays for delivery/fuel consumption"

Economy + Safety + Driving comfort
Experimental Plan

◆ 33 professional truck drivers
◆ Vehicle (38 T): Tractor Renault Premium Long Distance 420 dci + trailer
◆ Route = 170 km/105,65 Miles (alt=200-695 m) divided in 2 sections:
  ➢ Route A = 92 km/57,17 Miles, highways and urban areas,
  ➢ Route B = 78 km/48,48 Miles, motorways
◆ Experimental procedure (+/- 4h30):
  ➢ driving (+/- 3h) & various questionnaires (+/- 1h30)
  ➢ Vehicle data recording in real time acquisition on a PC file
  ➢ Road environment data recording with observation grids
Truck drivers’ behaviors and rational driving assistance

Experimental System

- Cognitive and conative factors
  - Knowledge
  - Workload
  - Experience

- Questionnaires, Cognitive + Personality tests, Representations, Workload Index

Vector CANalyser

Driver Behaviour Analysis

Actopalm

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Workload Driver Index (NASA TLX)

DRIVING TASK
Mental Demand
Physical Demand
Temporal Demand

Effort
Frustration
Own Performance

Subjective Workload

Workload Index

Overall Score
Mental Demand
Physical Demand
Temporal Demand
Effort
Frustration
Performance

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Results: Drivers' Workload

Workload factors analysis according to the route (n = 33)

- Varied roads Overall Workload > Motorways OW
- Focus on mental & physical demands, effort & frustration on varied roads

Route A = Varied roads
Route B = Motorways
Results: Driving Behaviors

Comparison of consumption and speed, by driver, on the route A (all roads)

- Great inter-individual variability: Consumption and Speed
- Dissociation Consumption/Speed
Results: Psychological & Cognitive Factors

No relation has been found between drivers' consumption and drivers' personality or cognitive styles

- Stress resistance of tested drivers
  - very resistant: 1 driver
  - resistant: 9 drivers
  - Fairly resistant: 21 drivers
  - Slightly resistant: 3 drivers
  - Not at all resistant: 0

Studies (Renault + INSA Lyon) have shown that it is preferable for a driver to be stress resistant or fairly resistant than very, slightly or not resistant

- There is no difference between our drivers' pattern of personality and the male's average pattern (EPI sources)
Conclusions (1)

- Dissociation consumption/speed =
  1. It is possible to reduce the fuel truck consumption without wasting time
- Drivers' consumption only depends on their own driving style (acceleration, braking, anticipation) =
  2. It is not possible to select truck drivers from their personality or cognitive style
- Fuel consumption mainly depends on drivers' cognitive acquired automatisms =
  3. Importance of first driving learning and rational driving trainings
Conclusions (2)

- One of the better solutions for reducing fuel consumption whoever drives the truck is to develop an adaptive assistance system for helping "bad" drivers without bothering "good" drivers especially on varied roads.
- Do not overlook driving learning and trainings.
- When the new system will be developed, make sure that it does not increase the drivers' workload.
- Be careful of the Human Machine Interface.
Interest

- Adaptation of a workload index for evaluating drivers' workload and failings of attention and vigilance induced by different technical systems (HMI, driving assistances, displays...)
- Design of a specific software for collecting and processing data by Vehicle ECU
- Updating of a database (signalisation, infrastructures...) for a simulation tool (Geode)
- Development of a new professional expertise in the firm
  - The Psycho-Cognitive Ergonomics