

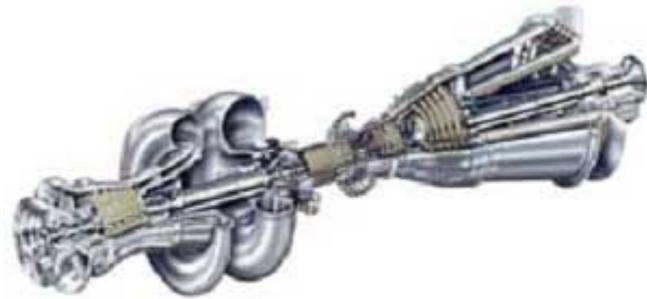
Driver Awareness Support

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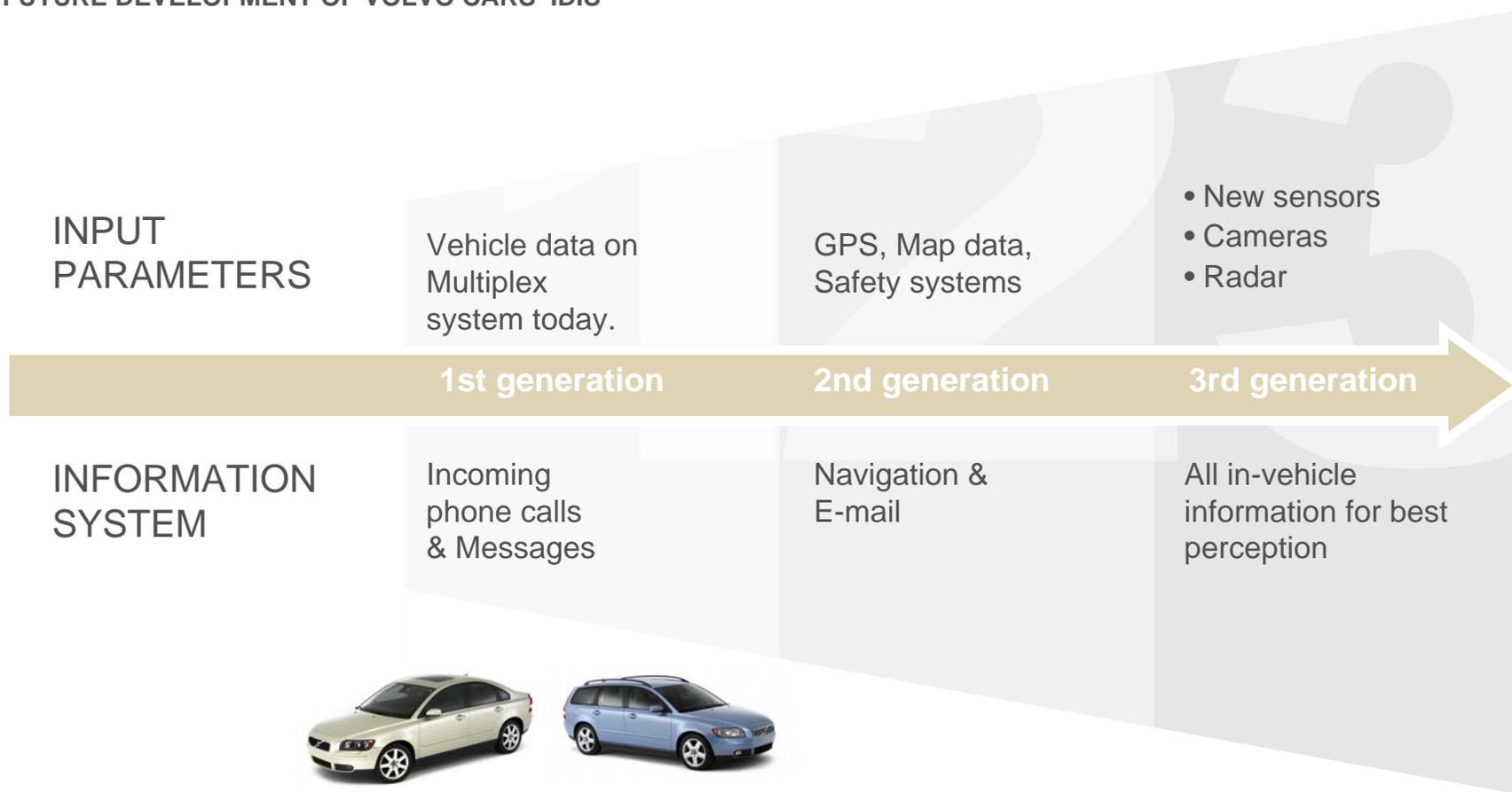
Volvo Technology





VOLVO

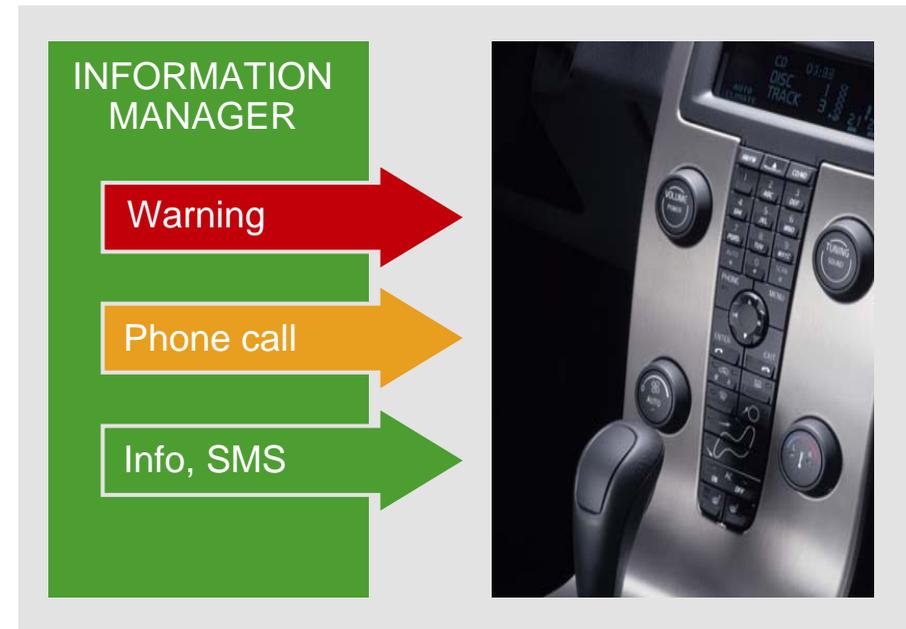
FUTURE DEVELOPMENT OF VOLVO CARS' IDIS



WORKLOAD ESTIMATOR



INFORMATION MANAGER

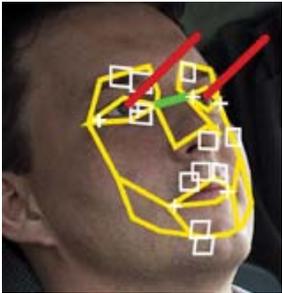


Volvo Trucks Safety Seminar May 10-12, 2004

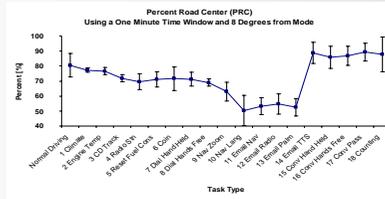
- Strong *company position* on integration and Driver Awareness Support
- Shows future safety functionality:
 - Long list of ADAS and IVIS functions...
- At many trade shows throughout the year



1. Sensors



2. Detection



3. Applications:

New Driver Awareness Support Areas:

1. Interaction Support
2. Drowsy Driver Alert
3. Distraction Alerts
4. Inattention Sensitive ADAS
5. Perceptual Enhancement
6. Perceptual Suitability Test

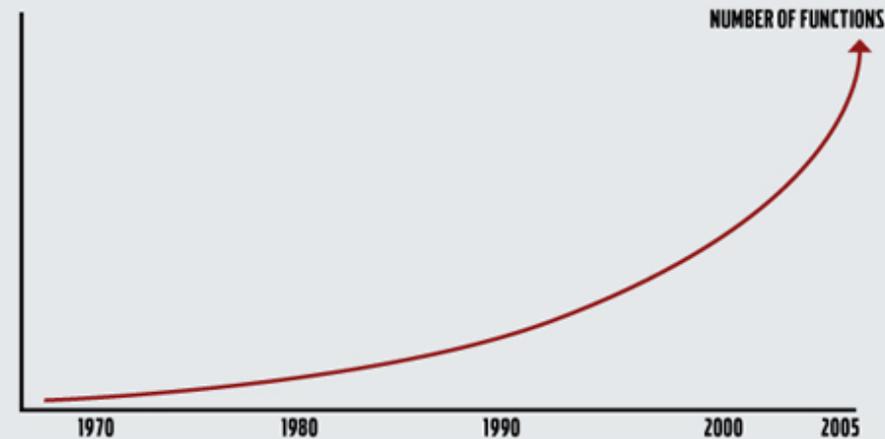
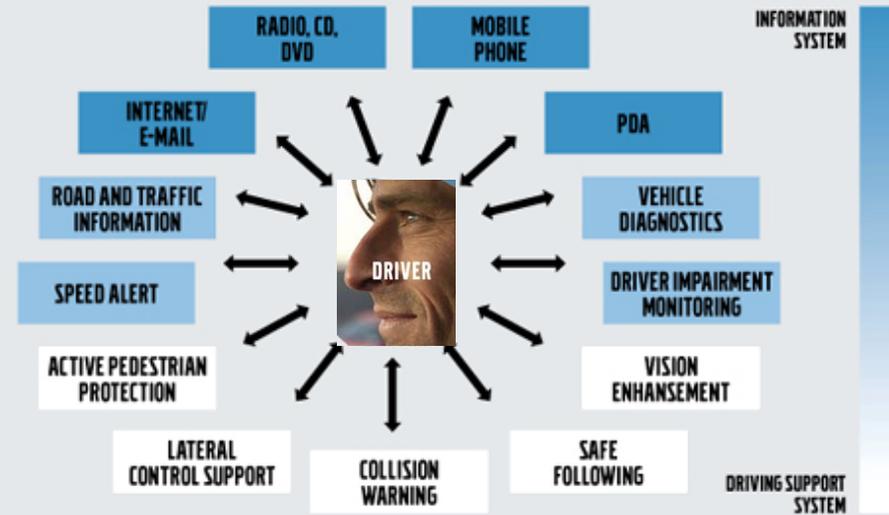
Designing out Distraction

Visual Demand Measurement Tool

Interaction Support

The central hub of the vehicle

- Manages *all* ADAS and IVIS functions in vehicle
- Improved workload estimation
 - New input parameters and advanced algorithms
- New workload management functions



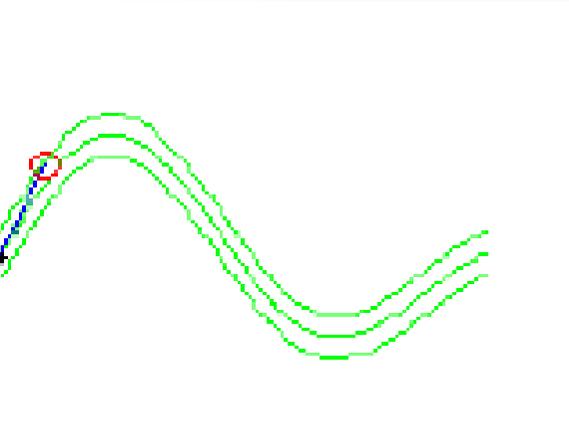
Interaction Support

Configurable Instrument Cluster

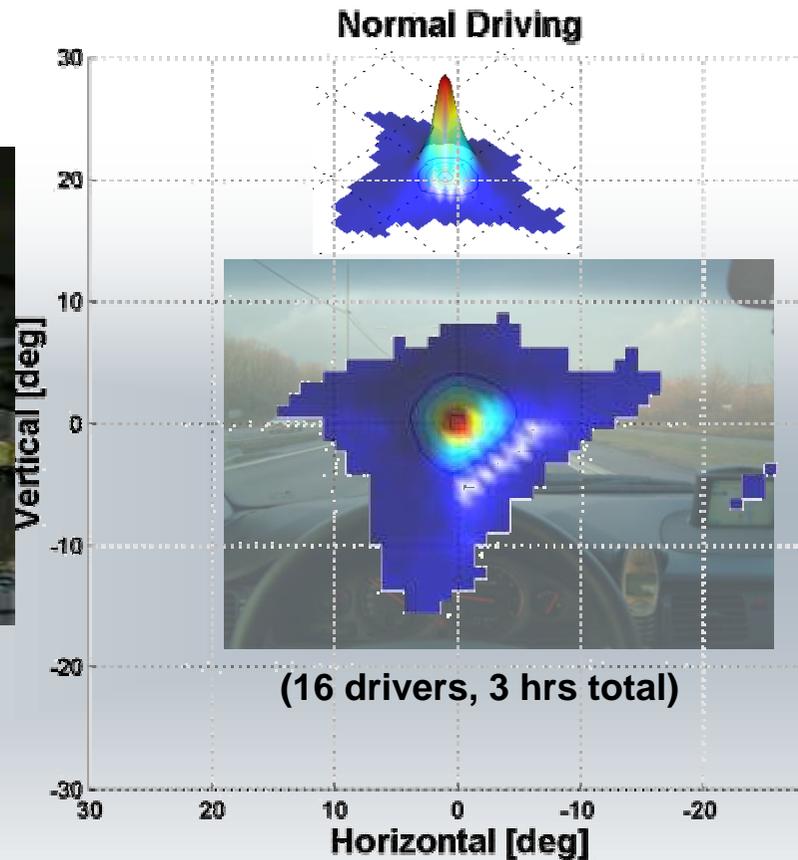
- Decides what, when and how information is shown
- Accurate information in the right time and in the right way reduces driver's stress
 - personalized
 - adaptive interaction



Eye Movements in Driving



Real projected eye movement data
(Wilkie and Wann, in press)



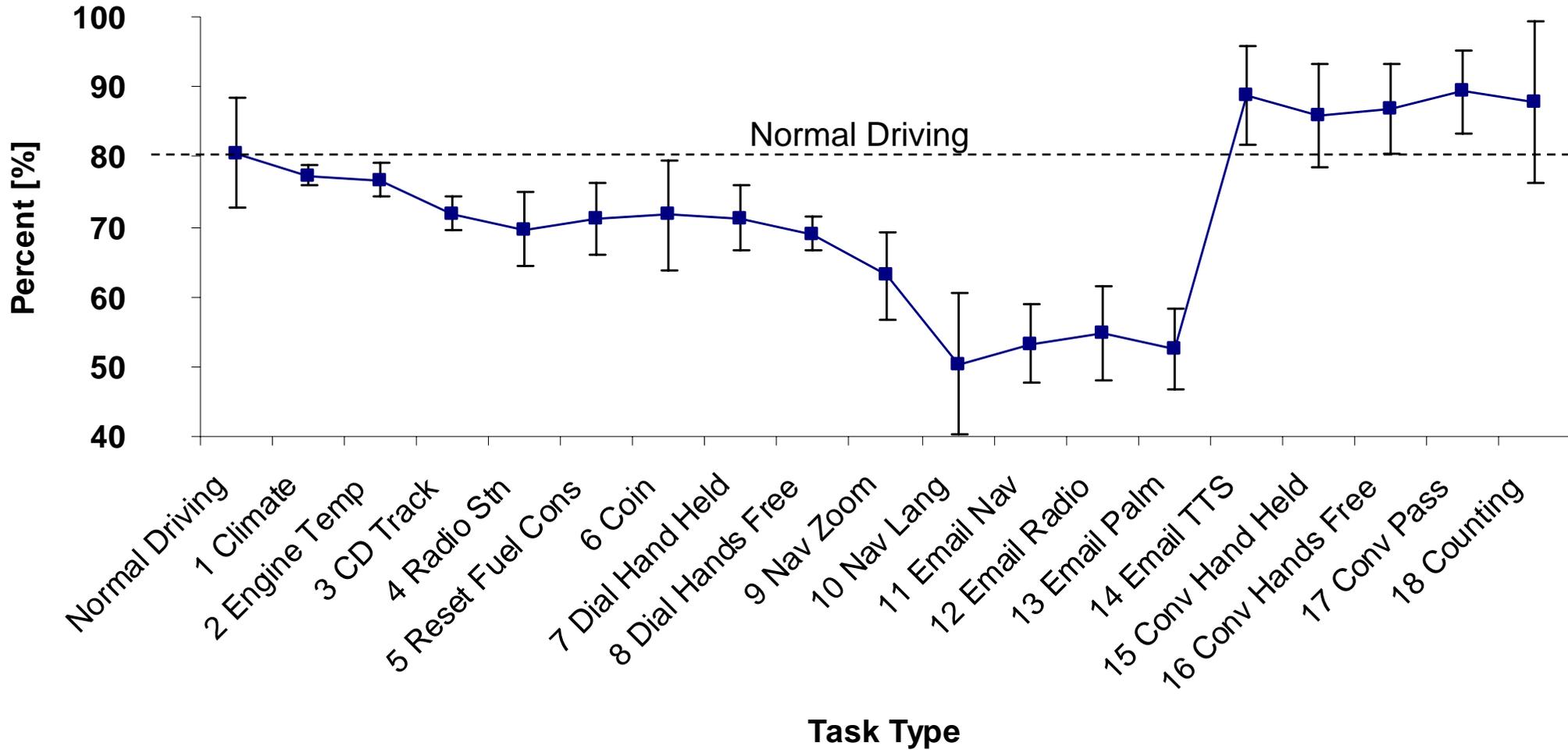
(16 drivers, 3 hrs total)

Drivers look straight ahead or at a point on the future path most of the time when driving (80 to 95%) – Comparing *future path* with *road*.

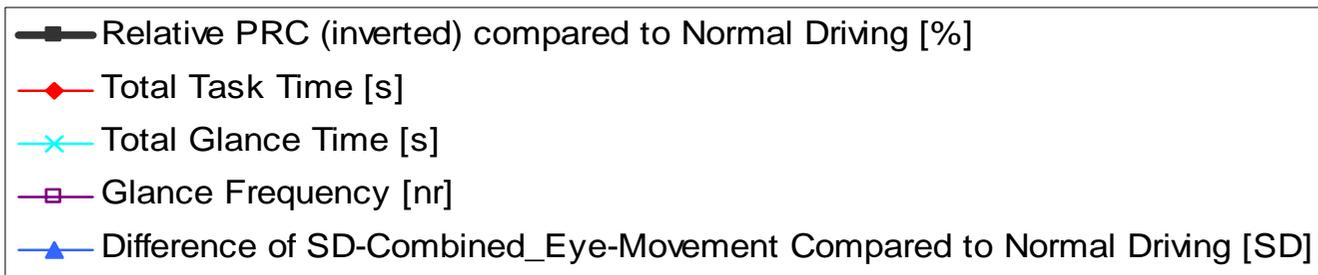
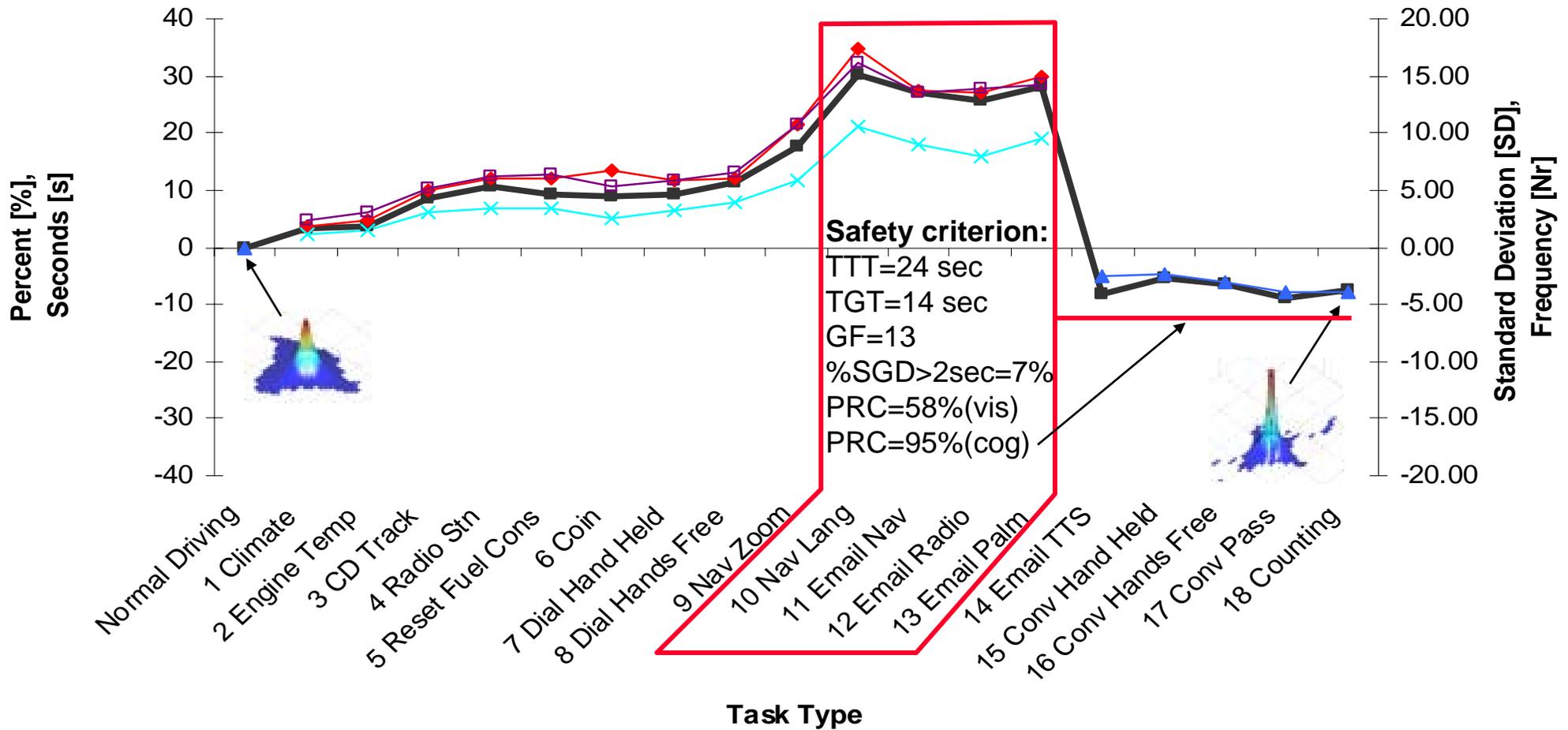
(Victor and Johansson, in prep; Cole & Hughes, 1988; Lansdown, 1996; Rockwell, 1972; Wierwille, 1993; Harbluk and Noy, 2002; Recartes and Nunes, 2002:2003; Wann and Land, 2000, etc, etc, etc.)

Percent Road Center (PRC)

Using a One Minute Time Window and 8 Degrees from Mode(Peak), 16 drivers



Percent Road Center (PRC) in Relation to Common Measures Of Distraction



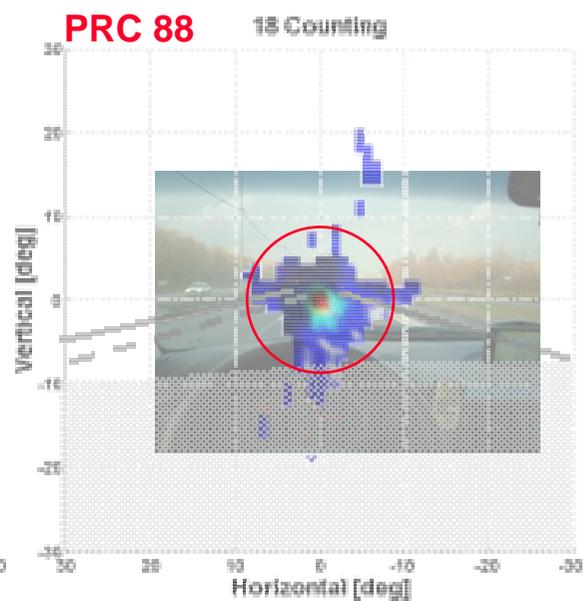
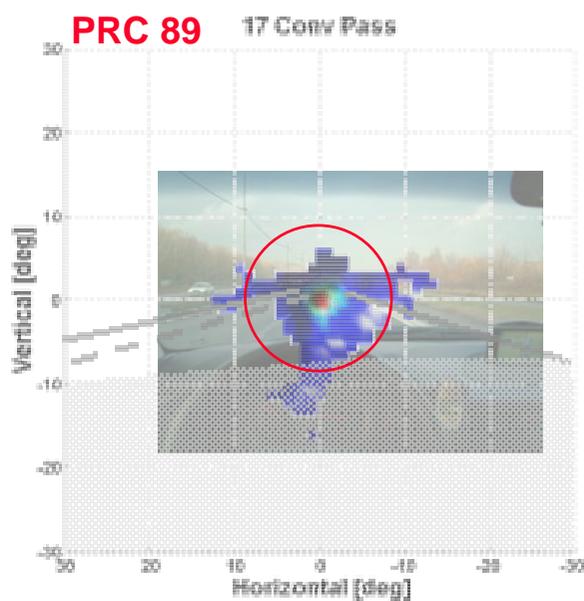
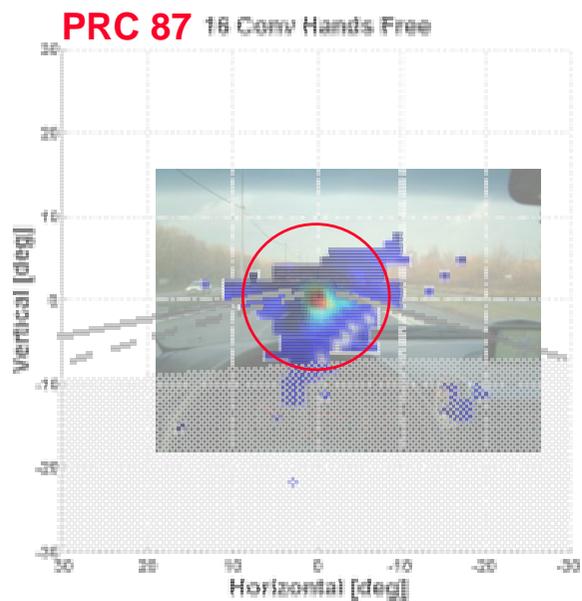
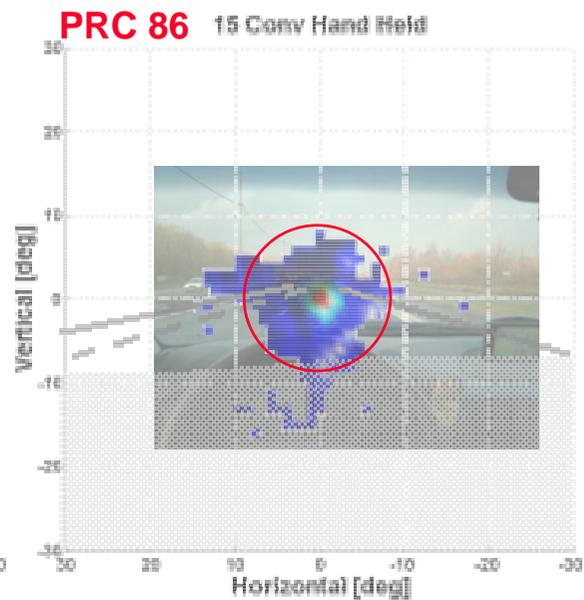
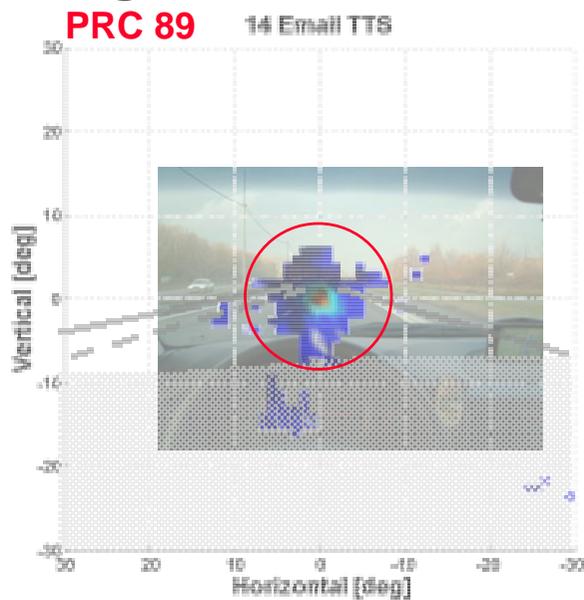
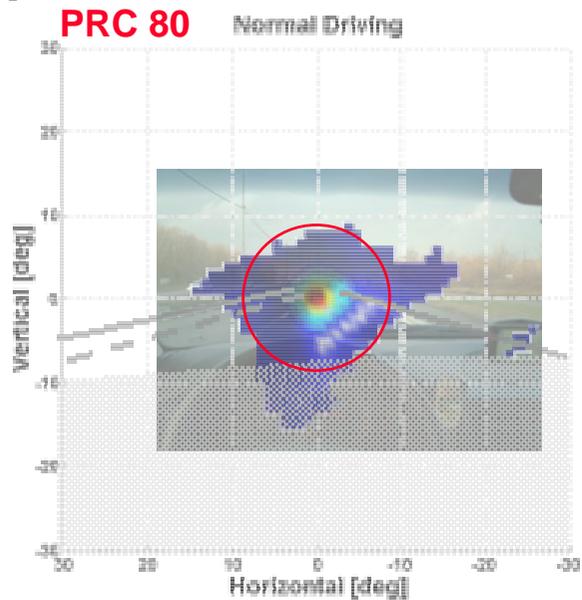
Visual Distraction Alert

- If the driver looks away for *too long* (long single glance) or *too often* (PRC threshold)
 - flashes of light (3 LEDs) along the dashboard intuitively lead the eyes back to the road
 - Generic, works on IVIS, nomads, non-tech, and external distractions
- 3 Focus groups
 - “non-foveal” warning essential
- Repetitive Heuristic Evaluations by experts in incremental, iterative design process
 - refined awareness concepts, removed “distractionmeter”
- 34 Truck drivers in on-road study with acceptance ratings and interviews
 - KISS removed 3 level warning
 - #1 function drowsiness, #2 distraction
 - ADAS=ADAS not “adapted”

[Alert Video 1](#) [First Version Video 2](#) [Video 3](#)
[On-road including adapted LDW](#)



Cognitive Distraction



Cognitive Distraction Alert

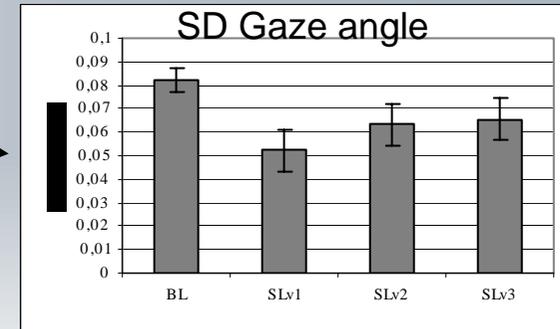
- If the driver is distracted by thoughts or telephone conversation
 - Flashes of light in the sides of the windshield remind the driver to scan more
 - Adapt warnings to the extra RT exhibited by cognitively distracted drivers
- Judgement errors because of looking *too much* at road center (Gray & Regan, 2000)
- Confound: need to partial out “good” gaze concentration from “bad”

[Alert Video 3](#)



Gaze Concentration and Performance

- PRC is a sensitive measure for both visual and cognitive distraction (e.g. validated in HASTE experiment: 48 subjects, 2735 glances *automatically* analyzed)
- Cognitively demanding tasks create:
 - *increased* spatial gaze concentration to road center.
 - *improved* lateral control performance
 - *reduced* event detection performance (e.g. Recartes and Nunes, 2003; Victor and Karlsson, in prep)



➤ **Event detection metrics are needed!**

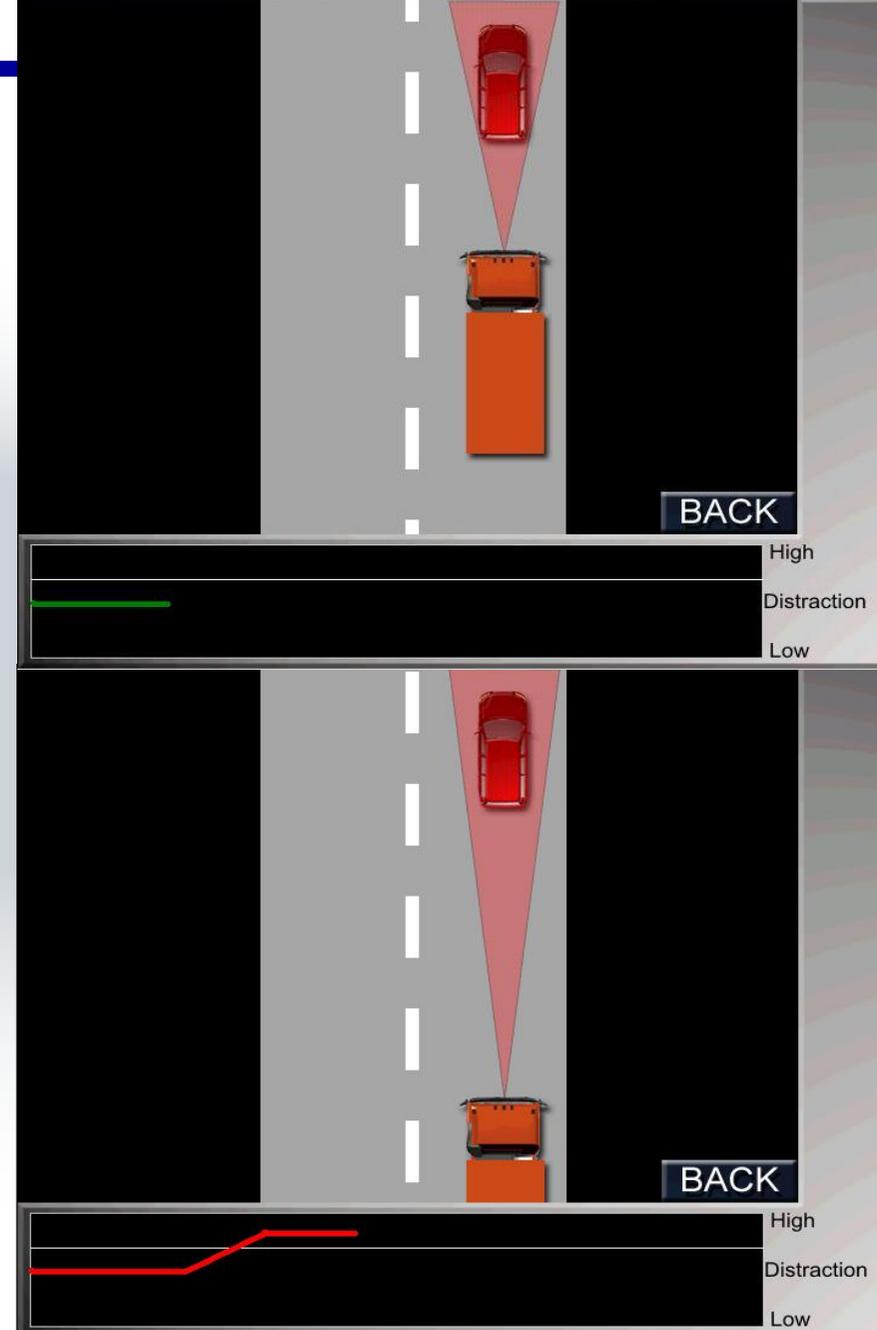
Inattention Sensitive ADAS

- All Advanced Driver Assistance Systems (ADAS) are integrated in Interaction Support and adapted to driver drowsiness, distraction, and workload states

- Examples:

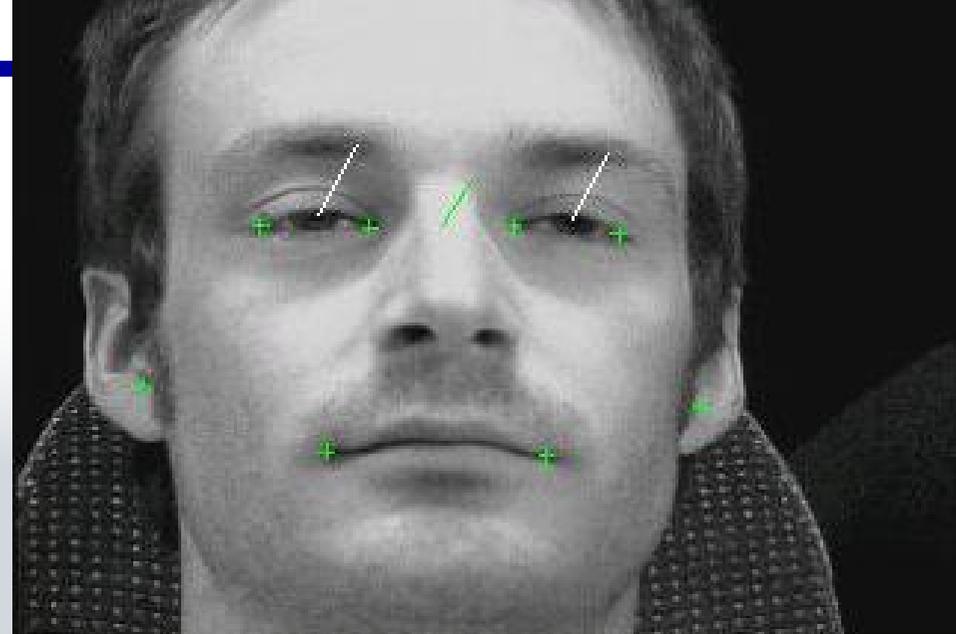
- Lane departure warnings only when a driver is inattentive (distracted and/or drowsy)
- Turn off cruise control if driver is distracted/drowsy
- Increase headway to lead vehicle in Adaptive Cruise Control function
- Earlier Headway Alerts if driver is inattentive
- Etc...

- Inattention detection one of many things that make ADAS perform better



Drowsy Driver Alert

- Detection is a combination of
 - the driver's eye, eyelid and head movements, detected by the eye movement camera
 - lane position sensor on the front of the cab detects side movement
 - jerky steering wheel movements are detected
- Warns a drowsy driver
 - sound warning
 - message in the instrument display (CIC)
 - seat vibrations
 - two levels
- Adapt ADAS functions



Perceptual Enhancement

- Peripheral Information Displays to enhance perceptions, head-up-display information, etc

Perceptual Suitability Test

- Alcohol, illegal drugs, prescription drugs, medical conditions...
- The eye camera detects if the driver is unfit to drive and prevents him from starting the truck – similar to alcohol ignition interlock, but can also be used while driving

Conclusions

- Strong company position on Driver Awareness Support
- Advanced development, product rollout planned in near future
- Worked for/with Volvo Cars (Ford) to put IDIS on market
- Future Distraction Alerts and Interaction Support functions will be "closer in time" to crashes, i.e. they will migrate from preventative safety to active safety