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HUMANIST SUMMER SCHOOL

Human Factor issues for the future car autonomous experience

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Overview of the session

- Short presentation of Ifsttar/Lescot, France
- Brief definitions of acceptability/acceptance, trust, situation awareness and workload and methodologies to evaluate these variables
- Framework of the interactive session
  - Setting up groups and handing out statements
  - Presentation of main comments for each group
- Wrap up of the session

Laboratory of Cognitive Ergonomics in Transport (Lescot)

Recommendations of design
Creation of methodologies
Safety evaluation
Design Guidelines for solutions

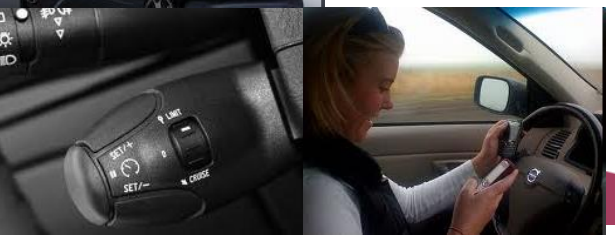
Real road Situations

Simulated Situations

Analysis of driving activity on diversified population

Analysis of perceptual and cognitive processes

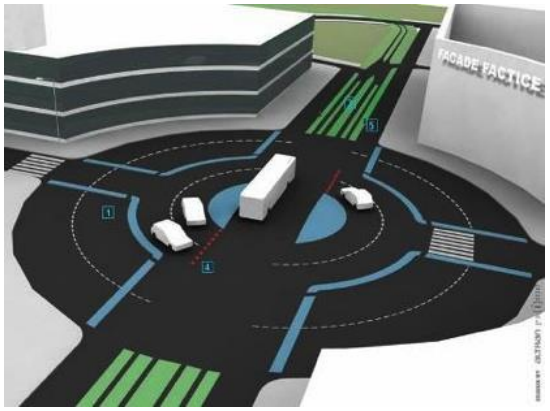
Conceptual modeling



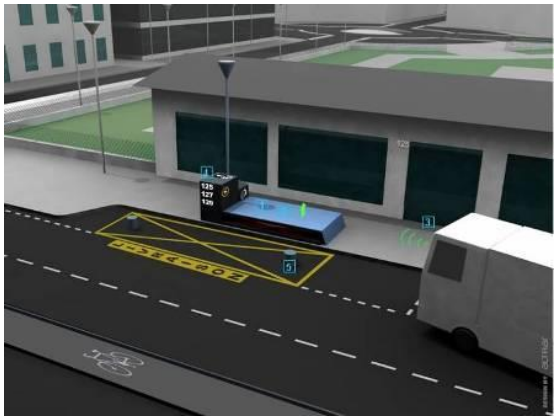
A new track at Ifsttar (end 2018-2019)

200 ACRES of urban mobility lab at 30 mn from **LYON**

Flexible roundabout

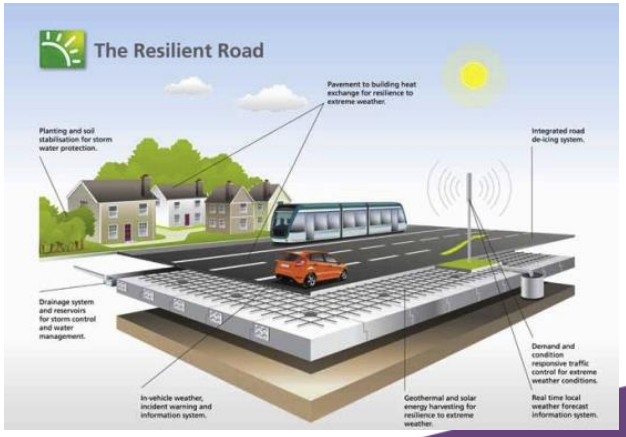


Connected delivery or bus stop zone

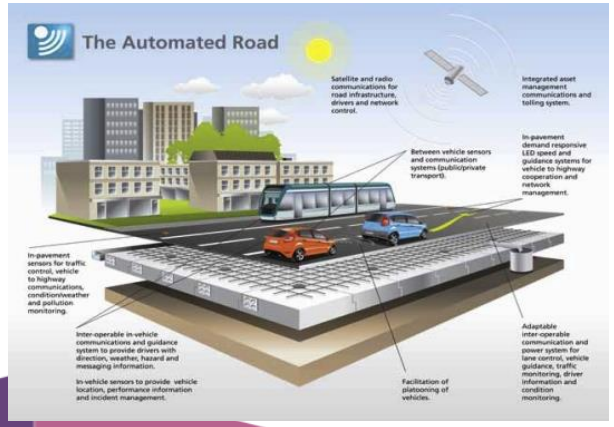


The adaptative road

The resilient road



The automated road



Research topics:

- Analysis of drivers' needs and functional capacities, acceptability, usability and safety of "Intelligent Transport Systems ", several national and European projects on design of IVIS & ADAS, and autonomous vehicle, in relation to road safety
- Setting up Human Centred Design criteria for developers and creating methods for systems safety evaluation
- Representative of French ministry in international and European committees
- Co-funder of the Humanist Network of Excellence in 2004

Recent projects:

2017-2020 **UThreat** *(**U**nderground **T**ransport **H**ub **R**esilience to **E**nsure **A**vailability and **T**ackle danger)*

2016-2020 **ADAS&ME** **(***Adaptative **ADAS** to support incapacitated drivers **& M**itigate **E**ffectively risks through tailor made HMI under automation)*

2016-2019 **AutoConduct** ***(****Adaptation de la stratégie d'**AUTO**matisation des véhicules autonomes (niveaux 3 et 4) aux besoins et à l'état des **CONDUCT**eurs en conditions réelles)*

2015-2017 **SERA** *(**S**écurité **E**t **R**éalité **A**ugmentée)*

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Different concepts of automated vehicle

Concept 1

The vehicle is still equipped with commands

Concept 2

The vehicle has no more commands

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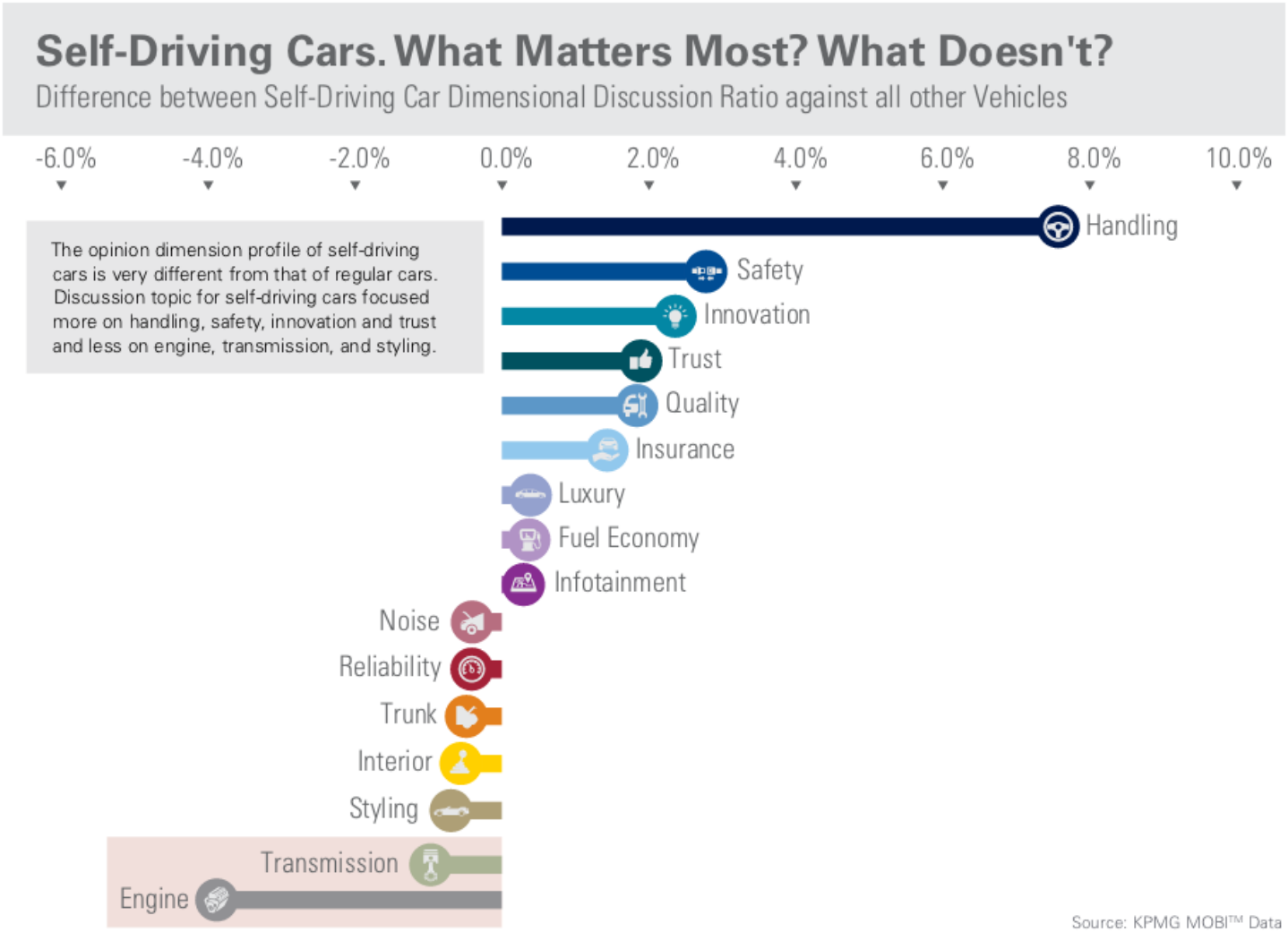

Source KPMG MOBI Data, 2014

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Driver Centred Approach of Automated Vehicle

Main human factors issues raises by automated driving:

- **acceptability**
- **acceptance**
- **trust**
- **situation awareness**
- **mental workload**

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Driver's acceptability of automated systems

ACCEPTABILITY before use: "Perceived usefulness and perceived ease of use influenced by belief, concern and expectation" with social acceptability issue related to deprive personal control of vehicle

- ***Methods (isolated or combined)***: direct and online questionnaires, large scale surveys (representative of the drivers population), focus group, in-depth interviews

Bias due to imagination and

not actual experience

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Driver's acceptance of automated systems

ACCEPTABILITY during use (ACCEPTANCE):

" Linked to usability characteristics of the system and to trust, vital for successful implementation"

Methods: most of the investigations aiming at acceptance assessment of automated vehicle have been conducted on driving simulator (analysis of behaviour, workload and subjective preferences), no standardized measurement procedure available nowadays

Driver's trust of automated systems

TRUST : « key variable for reliance, can lead to misuse of automated systems, with a direct impact on the level of acceptance »

- Resulting from interaction between individual profile (culture, age, gender, personal traits), situational trust (setting, difficulty, task, risk), initial learned trust (pre-existing knowledge), and dynamic learned trust (system performance, reliability, validity, errors)
- ***Same methods than acceptability*** *(investigation can be conducted before and after the automated driving practice)*

Issues in lack of trust and in over-trust

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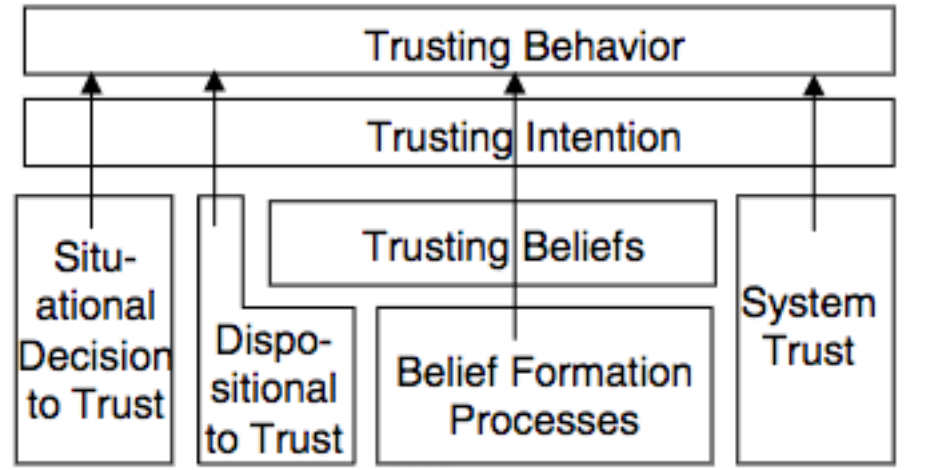
Driver's trust of automated systems



Note: Arrows indicate relationships and mediated relationships

- Questionnaires and in-depth interviews before and after driving,
- Horizontal gaze behavior could not be confirmed as a metric for measuring trust in automation (Gold & al., 2015)

Driver's situation awareness of automated systems

SITUATION AWARENESS: "knowing what's going on so you can figure out what to do",

- direct consequence of drowsiness, distraction, health status, fatigue, vigilance and involvement in activities not linked to driving task
- automation can impoverish situation awareness, with longer reaction time

Methods

- Situation Awareness Global Assessment Technique (**SAGAT**): objective measure but requires freezing picture of the surrounding
- Situational Awareness Rating Technique (**SART**): subjective rating of situational awareness declared by the participant, can be used in real road driving context
- Driver's behaviour analysis: recording driver's eye-movements and attitude

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Driver's workload of automated systems

WORKLOAD: "cognitive resource allocated to a task by the driver », depends of the task demands. Critical scenario when driver will have to perform transitions from automated to manual control.

Methods

- Physiological measurements: technical difficulties in real road context
- Dual-task method: create artificial experimental context
- Driver's self-assessment: estimation from individual's reports concerning the workload or effort expenditure that was experienced during the task (NASA-TLX and DALI)

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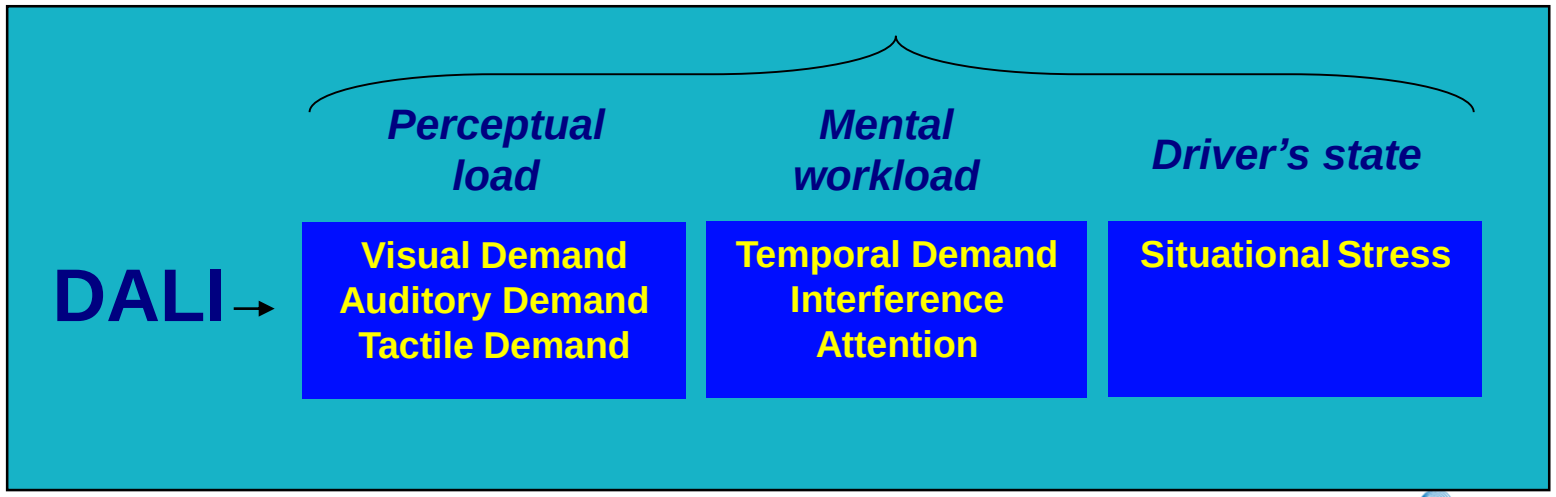
Tool for evaluation of the driver's mental workload

DALI (Driving Activity Load Index) – revised version of the NASA-TLX in order to fit with the driving task

- **Perceptual load** : visual, auditory, tactile ;
- **Cognitive load** : attention, temporal, interference
- **Driver's state** : situational stress.



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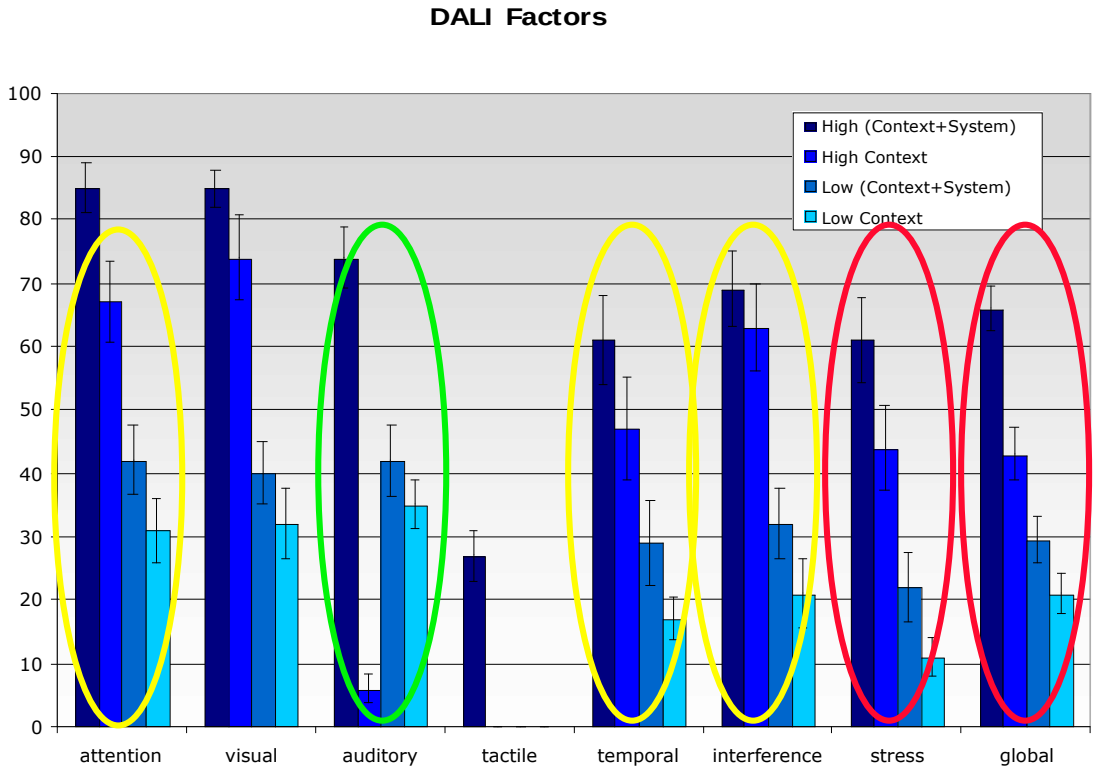
Tool for evaluation of the driver's mental workload



Significant difference of workload between the 4 tested situations for the **global** score and the driver's **stress**

Significant workload linked to **auditory** perception in the 3 situations involving auditory messages in comparison with the situation with no auditory stimulation

Significant workload linked to cognitive processes (**attention** & **interference**) and linked to **timing** for the 2 high constraining situations in comparison with the 2 low constraining situations

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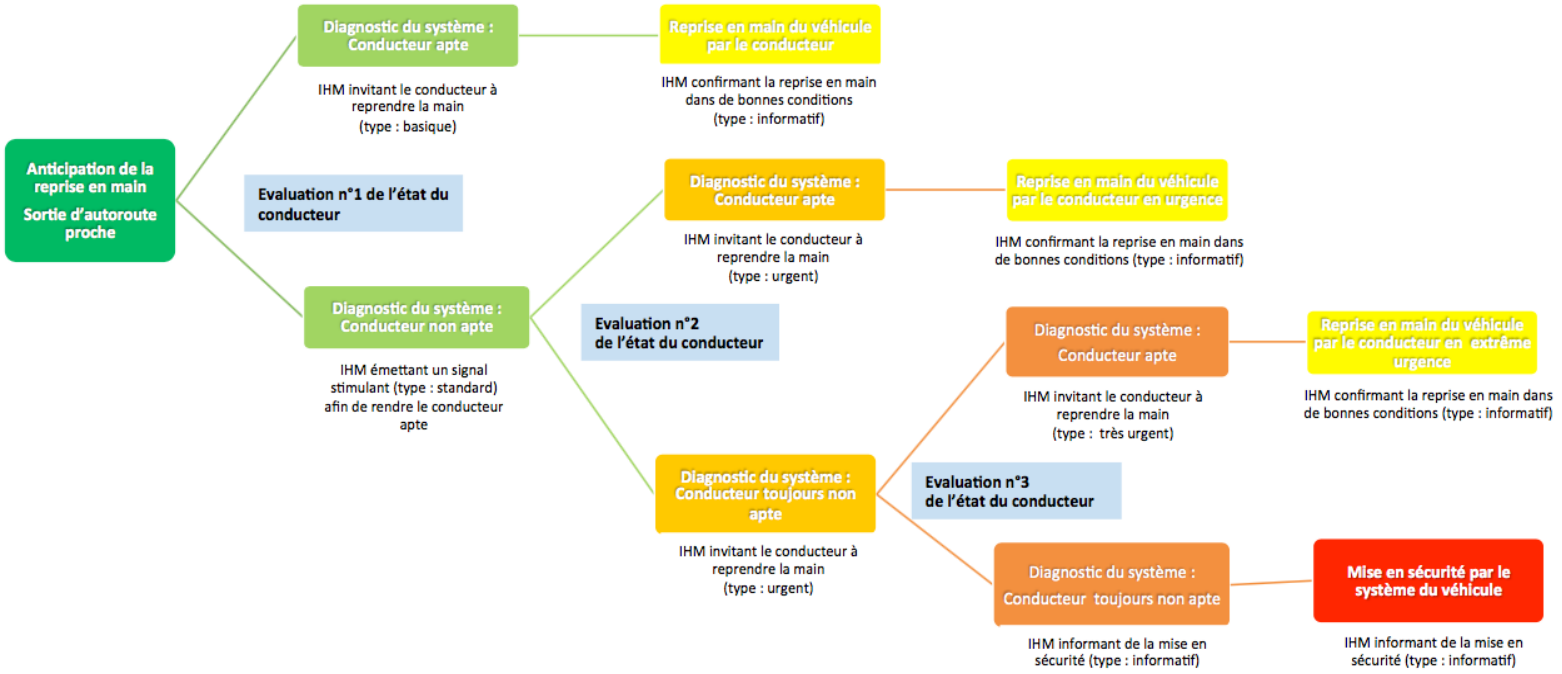
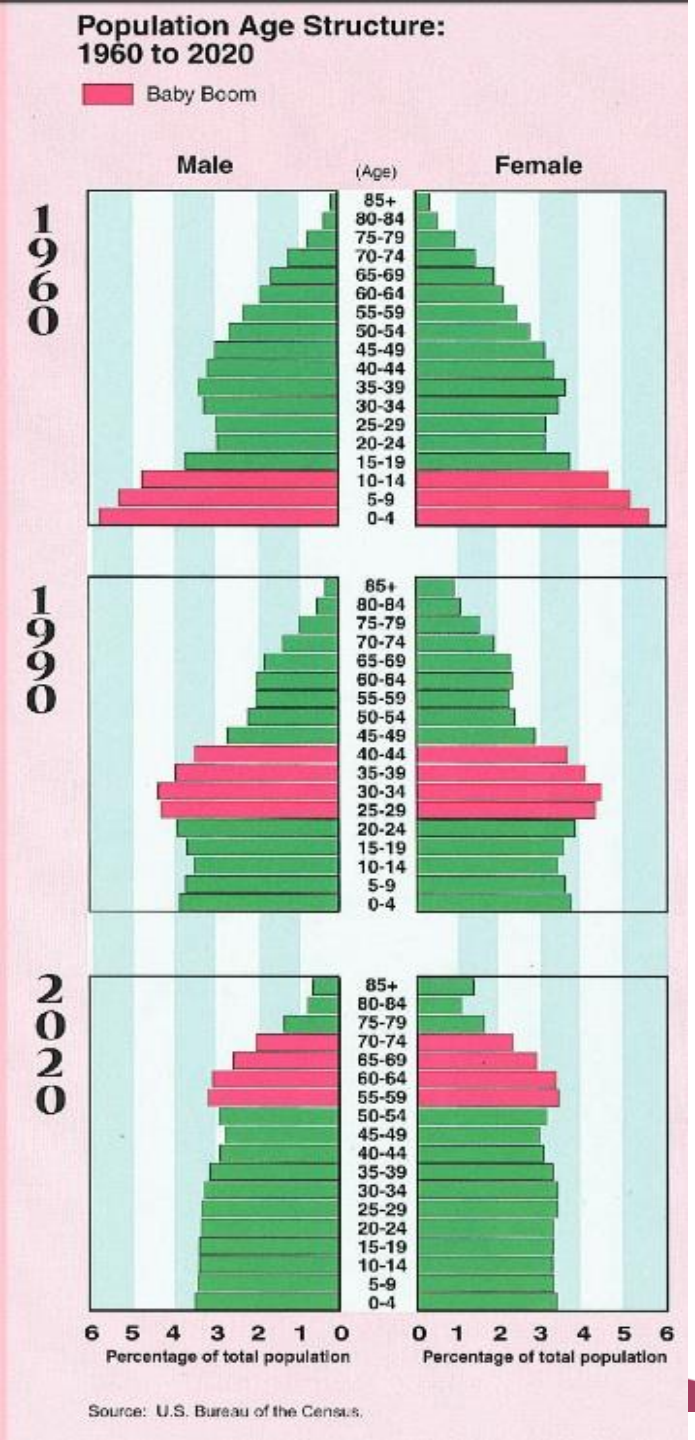
Contexts of automated driving requiring evaluation
of acceptability, trust, situation awareness, workload

- Planned transition from automatic to manual driving: design of HMI varying by their degree of intrusiveness (situation awareness & workload)
- Unplanned transition due to, for example, technical problems (situation awareness & workload)
- Compatibility between automatic driving style and human driving style (acceptance)
- Monitoring driver/system (acceptance, trust & workload)



Interactive session

- Setting up groups and handing out statements
- Presentation of main comments for each group



Conclusion

A specific focus on ageing of the population and increase in the ratio of seniors
« no more age pyramid but age square »

- Added value of the automated vehicle

for senior mobility and road safety

- Adapted design taking into account their functional abilities, their acceptance, their trust, their needs and requirements

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Conclusion

- **Methodologies in real road context:** to investigate drivers' acceptance, trust, situation awareness and mental workload ***need to be validated in this innovative context of automation***
- **High inter-individual variability:** to ensure that experimental tests will cover and so reflect the diversity of drivers population (age, culture, experience, personality profile, driving style)

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