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Canadian Council of Motor Transport Administrators
Conseil canadien des administrateurs en transport motorisé

BIENVENUE ASSEMBLÉE ANNUELLE 2018 DU CCATM

WELCOME TO THE 2018 CCMTA ANNUAL MEETING

QUÉBEC

DISTRACTED DRIVING: WHAT RESEARCH REVEALS

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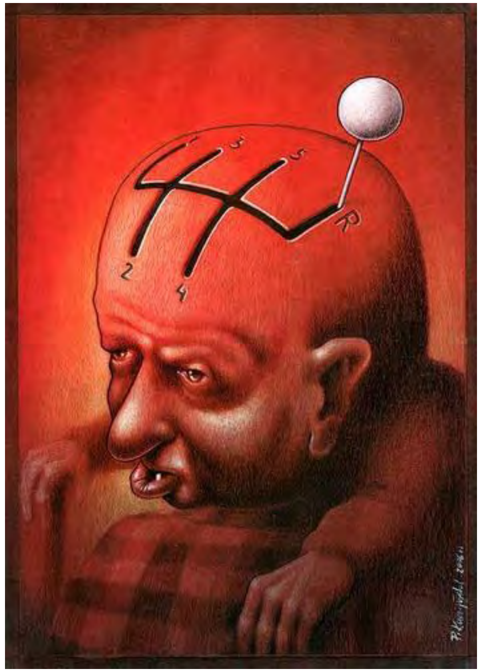
REPAR & RRSR

REPAR
RÉSEAU PROVINCIAL DE RECHERCHE EN ADAPTATION-RÉADAPTATION

UQAC
Université du Québec à Chicoutimi

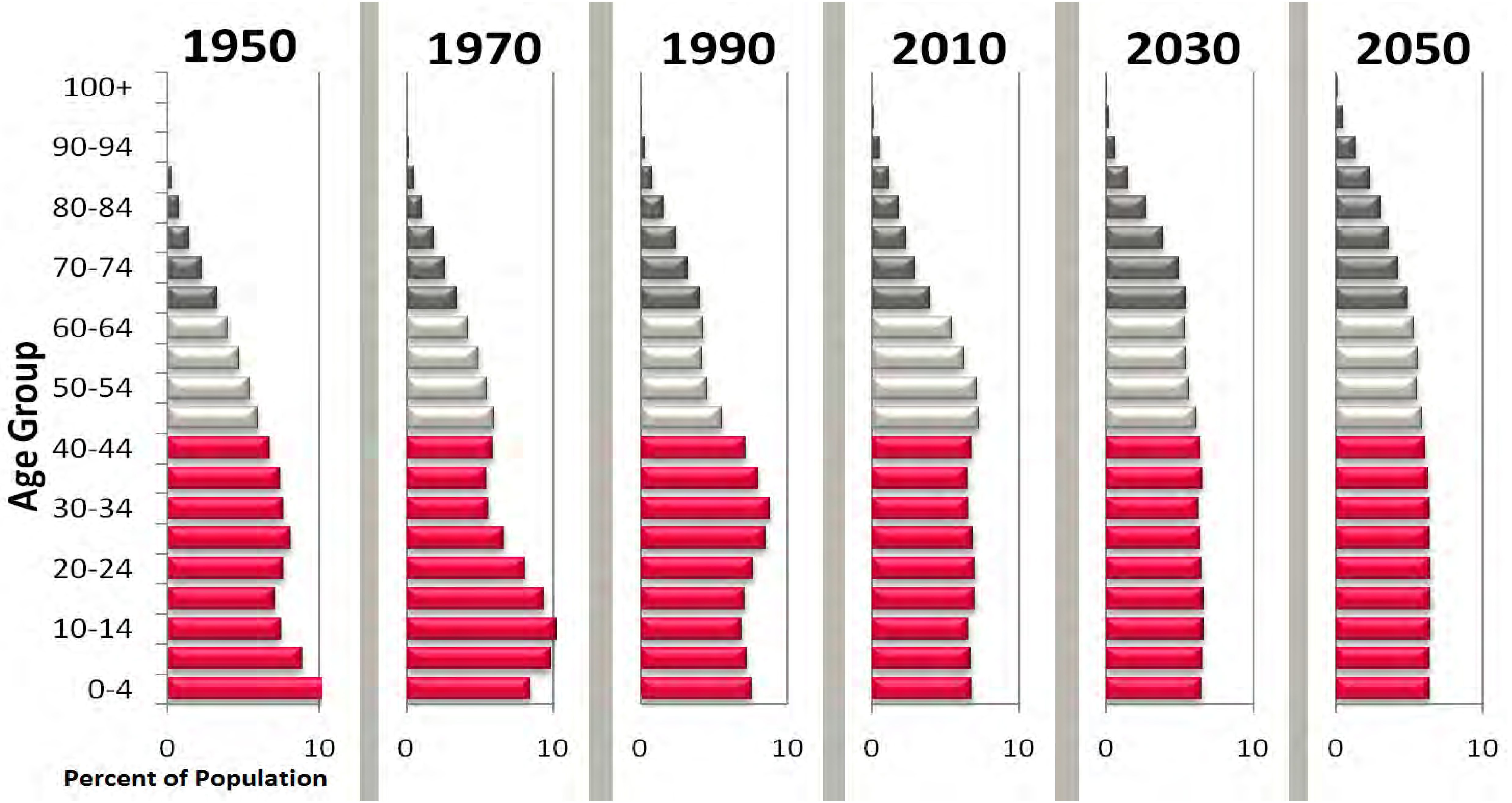


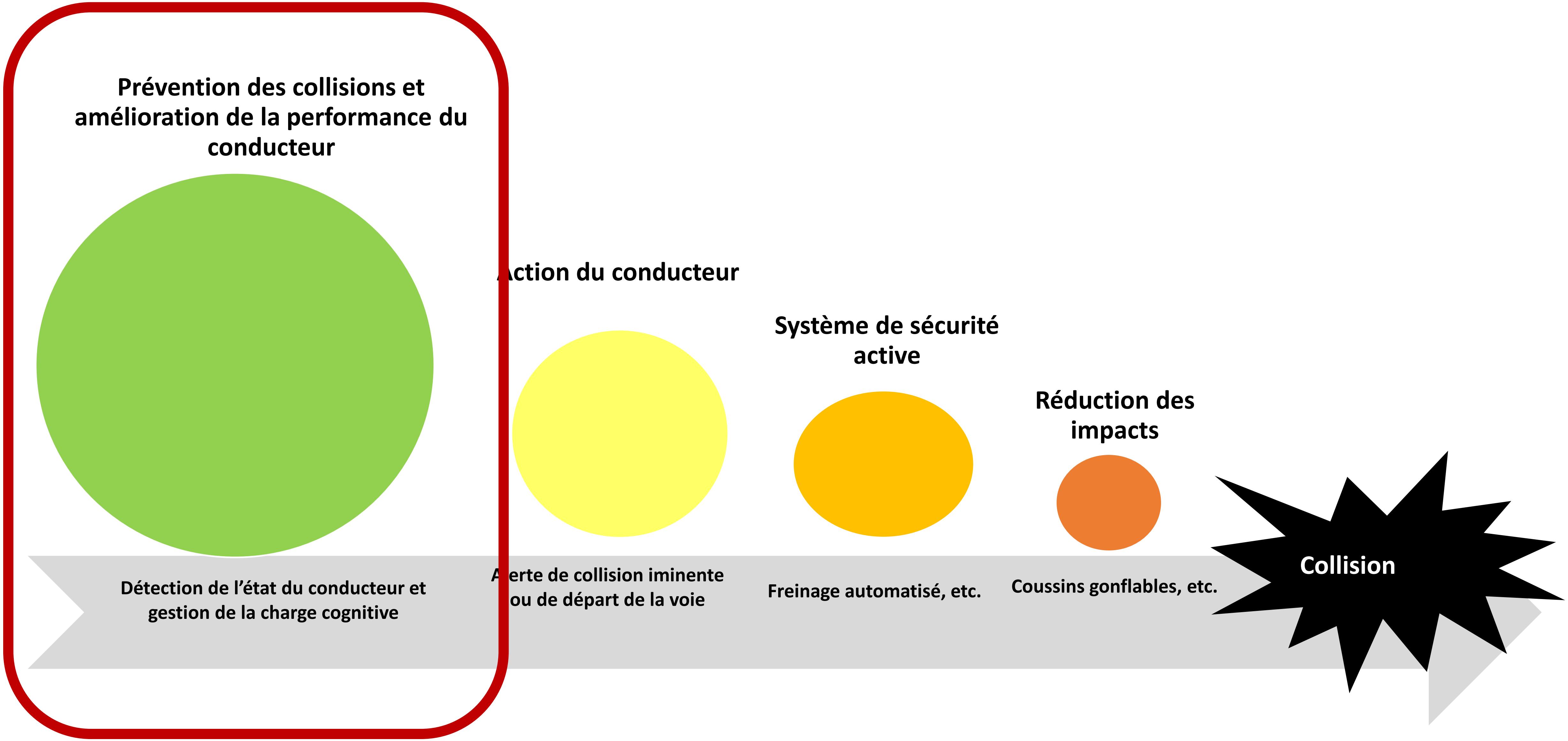
Who is a good driver ?

Qui est un bon conducteur ?

Introduction

- Driving as a sign of autonomy and independance
- One’s need vs Others’ safety
- Impacts of different factors
  - Aging
  - Technologies


1950
1970
1990
2010
2030
2050
100+
90-94
80-84
70-74
60-64
50-54
40-44
30-34
20-24
10-14
0-4
Age Group
0
10
Percent of Population


Prévention des collisions et amélioration de la performance du conducteur
Action du conducteur
Système de sécurité active
Réduction des impacts
Collision
Détection de l’état du conducteur et gestion de la charge cognitive
Alerte de collision iminente ou de départ de la voie
Freinage automatisé, etc.
Coussins gonflables, etc.

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Mental workload when driving in a simulator: Effects of age and driving complexity

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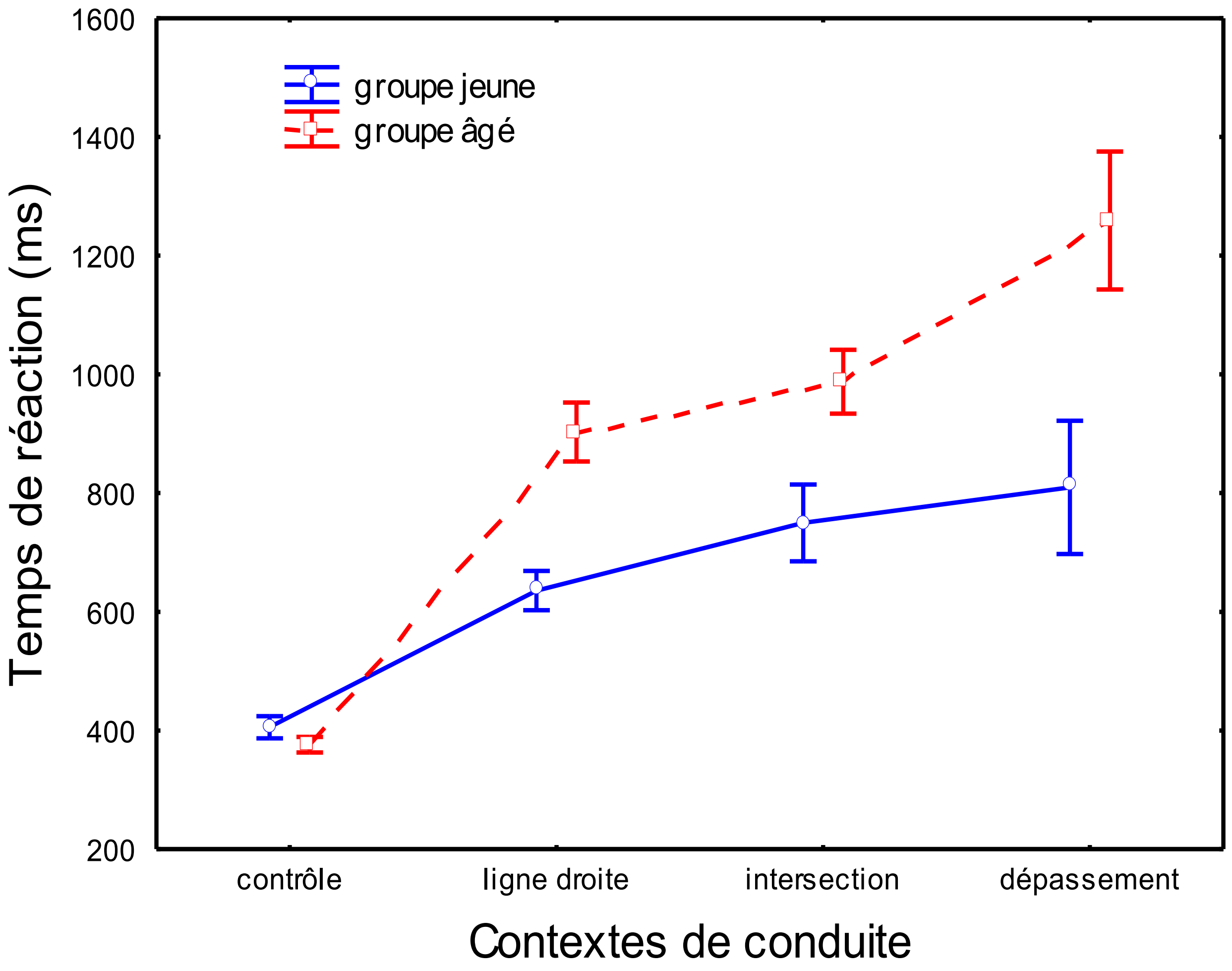
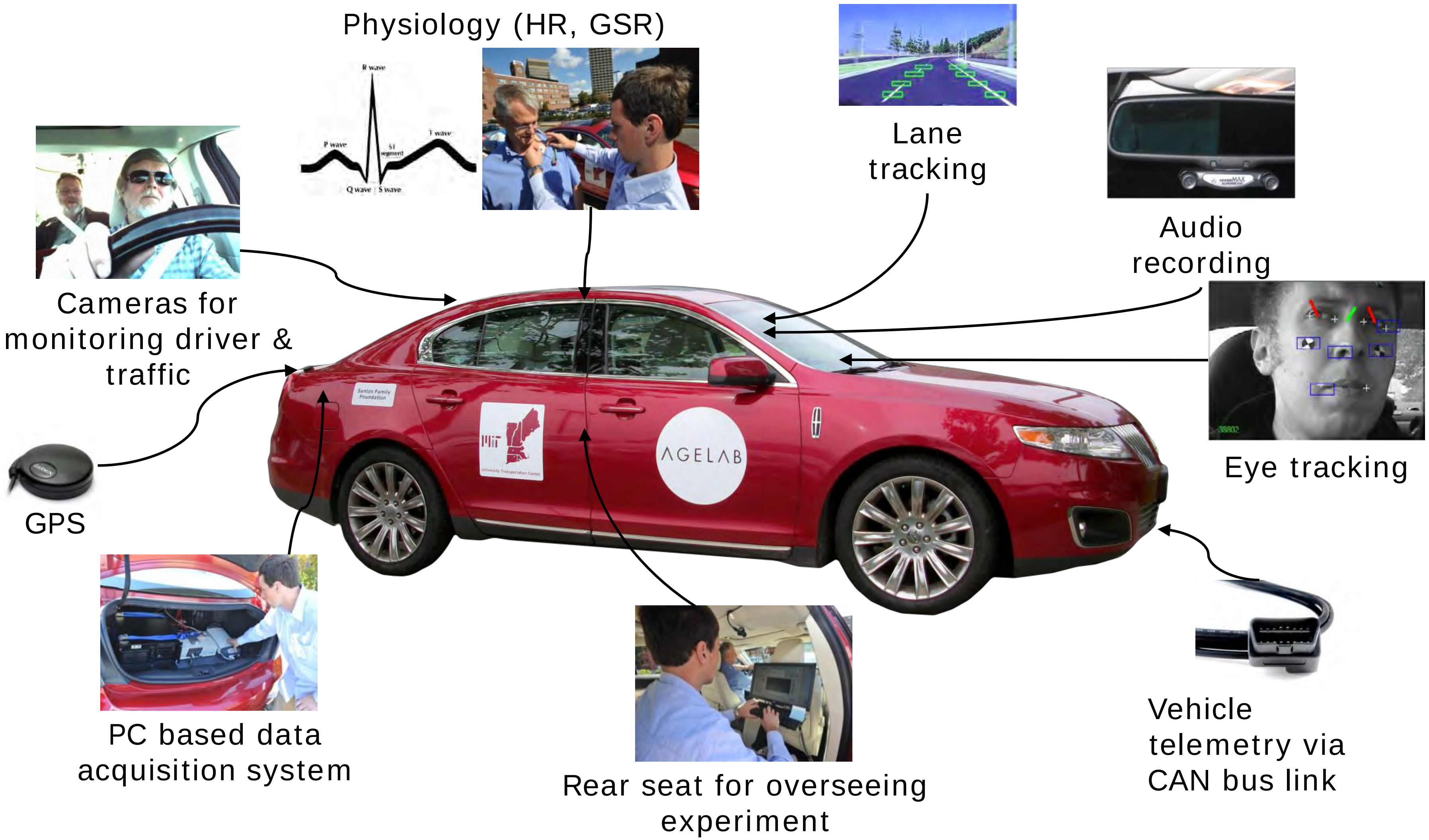


- ↗ Reaction time with an increase complexity of driving context

- ↗ Reaction time :
  Older > Young

MIT AgeLab Instrumented Vehicles



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Accident Analysis and Prevention

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Impact of age and cognitive demand on lane choice and changing under actual highway conditions

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A R T I C L E   I N F O

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A B S T R A C T

Previous research suggests that drivers change lanes less frequently during periods of heightened cognitive load. However, lane changing behavior of different age groups under varying levels of cognitive demand is not well understood. The majority of studies which have evaluated lane changing behavior under cognitive workload have been conducted in driving simulators. Consequently, it is unclear if the patterns observed in these simulation studies carry over to actual driving. This paper evaluates data from an on-road study to determine the effects of age and cognitive demand on lane choice and lane changing behavior. Three age groups (20–29, 40–49, and 60–69) were monitored in an instrumented vehicle. The 40's age group had 147% higher odds of exhibiting a lane change than the 60's group. In addition, drivers in their 60's were less likely to drive on the leftmost lane compared to drivers in their 20's and 40's. These results could be interpreted as evidence that older adults adopt a more conservative driving style as reflected in being less likely to choose the leftmost lane than the younger groups and less likely to change lanes than drivers in their 40's. Regardless of demand level, cognitive workload reduced the frequency of lane changes for all age groups. This suggests that in general drivers of all ages attempt to regulate their behavior in a risk reducing direction when under added cognitive demand. The extent to which such self-regulation fully compensates for the impact of added cognitive demand remains an open question.

Fréquence de vérification visuelle d'une région d'intérêt selon l'âge, la tâche et la direction du changement de voie

Objective

- Evaluate the impact of different tasks on driving among 2 groups of drivers (20y.o. and 60 y.o.)

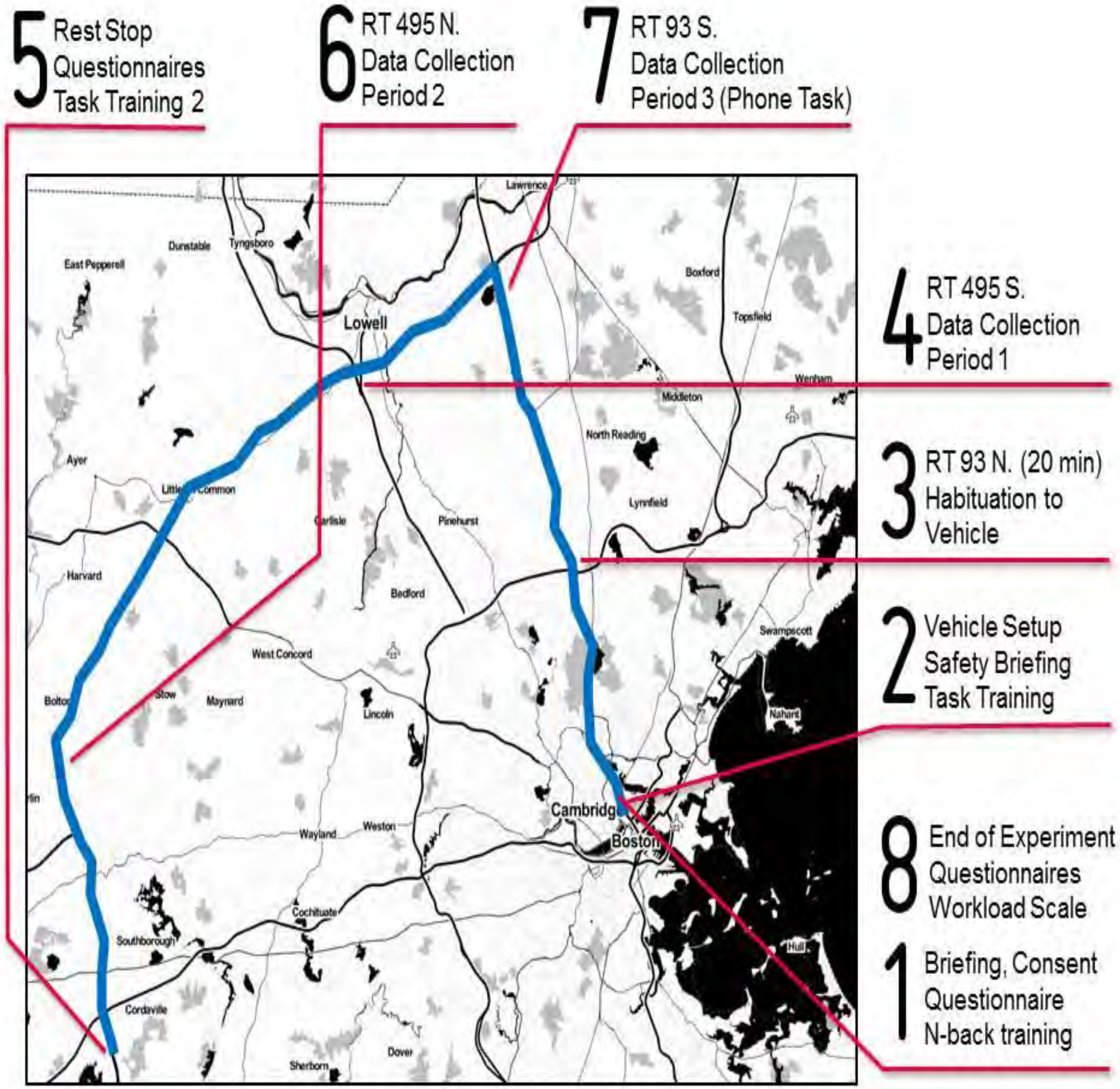
- **White Paper 2013-18A**
- **The Effects of a Production Level "Voice-Command" Interface on Driver Behavior: Summary Findings on Reported Workload, Physiology, Visual Attention, and Driving Performance**

AGELAB

Methods

- Participants
- Active drivers (at least 3 times/week)
  - 60 Men and Women
  - 20-29 y.o.
  - 60-69 y.o.

Experimental road and key procedures



Tasks

- N-back (0, 1 et 2)
  - https://www.youtube.com/watch?v=08tbf7ak-wU&feature=youtu.be
  - http://agelab.mit.edu/delayed-digit-recall-n-back-task
  - http://agelab.mit.edu/study-tools
- Radio control : manual
  - Easy (button pressing) and Hard (rotating knob)
  - https://www.youtube.com/watch?v=Kmd6oI2FWBc&feature=youtu.be
- Radio control : verbal command (possible and impossible)
- Phone call (vocal command)
- Navigation entry (entry and cancelation)
  - https://www.youtube.com/watch?v=X6gzg9k6T1U&feature=youtu.be

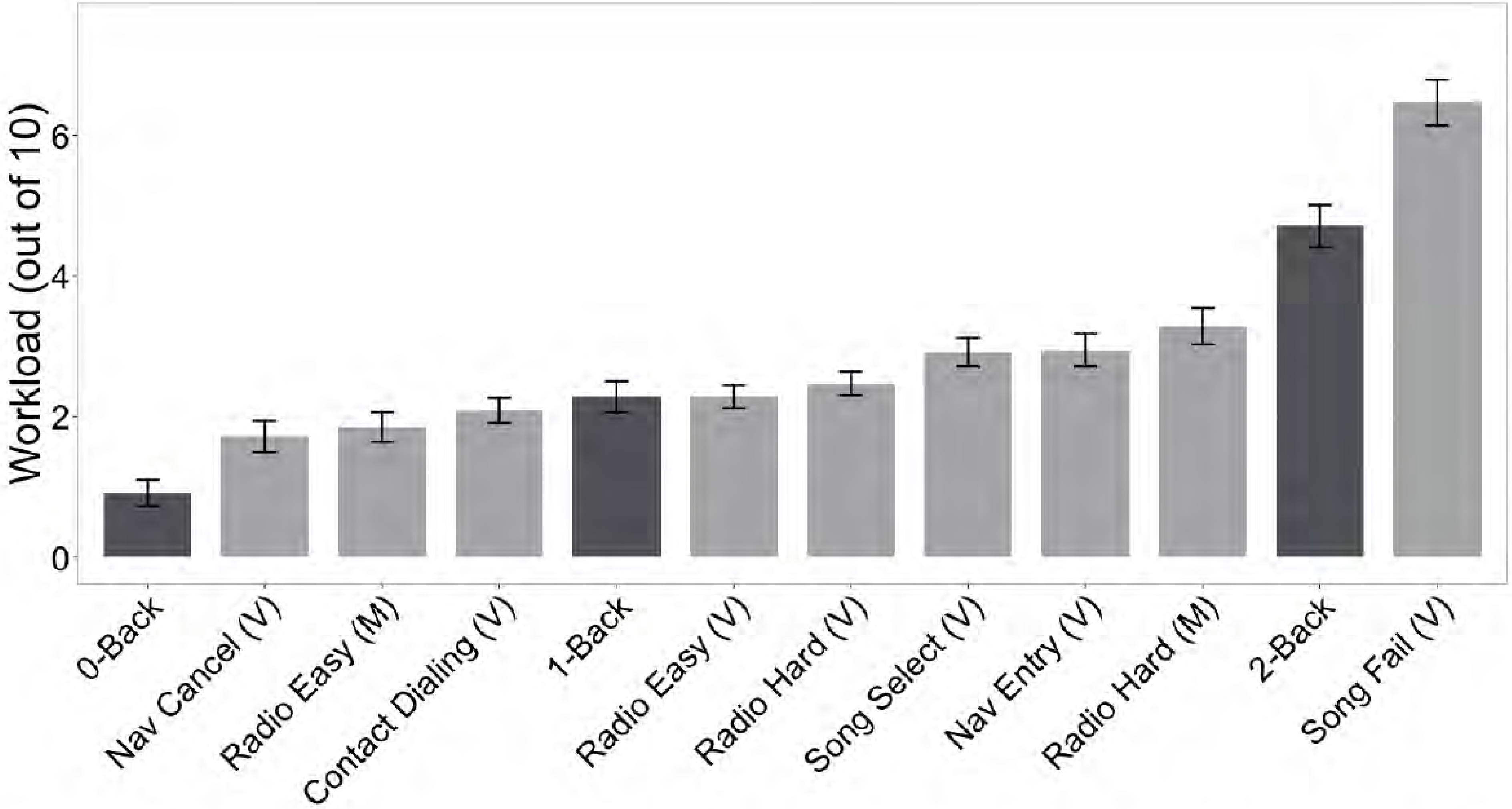


Figure 1. Tasks listed in ascending order for mean reported workload level. N-back reference tasks are denoted with darker bars. Error bars represent 1 SEM. Tasks marked (V) used the voice interface. Tasks marked (M) utilized traditional manual/tactile interactions. (Figure adapted from (Reimer, Mehler, McAnulty, et al., 2013).)

http://agelab.mit.edu/files/MIT_AgeLab_White_Paper_2013-18A_(Voice_Interfaces).pdf

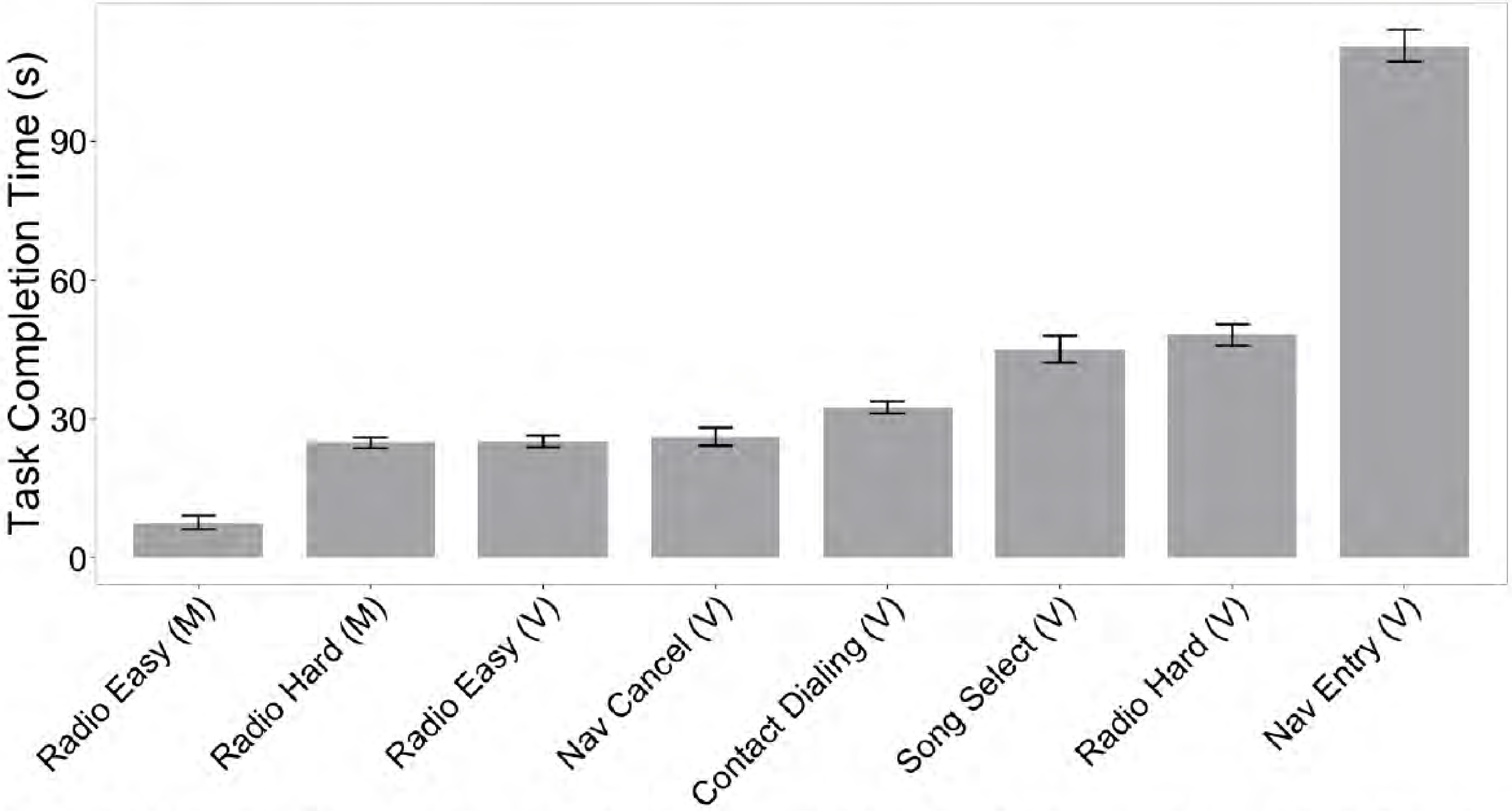
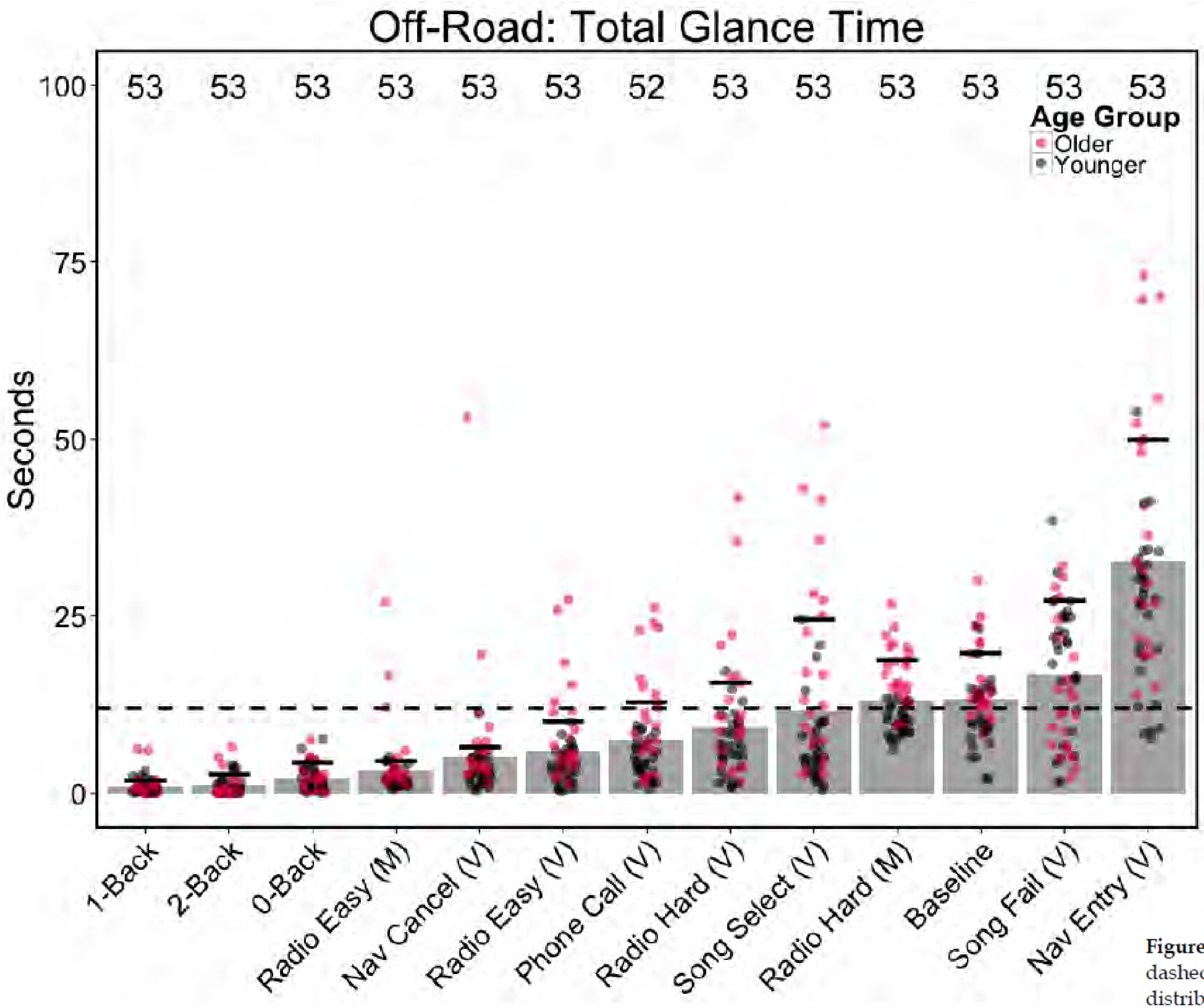


Figure 3. Tasks listed in ascending order for the amount of time needed to complete each task. Error bars represent 1 SEM. Tasks marked (V) used the voice interface. Tasks marked (M) utilized traditional manual/tactile interactions. (Note: the n-back tasks and song fail task are of fixed duration and therefore are not represented in the plot.)

http://agelab.mit.edu/files/MIT_AgeLab_White_Paper_2013-18A_(Voice_Interfaces).pdf



- ***Visual-Manual NHTSA Driver Distraction Guidelines For In-Vehicle Electronic Devices.***

Figure 5. Total off-road glance time for each task with the NHTSA (2013) 12 second threshold shown as a dashed line. The individual line segments above each bar represent the 85% point in the sample distribution for each task. One outlier data point in the Nav Entry task is excluded from view to improve the readability of the plot. Note that the NHTSA threshold values are shown here for discussion purposes only since, among other considerations, the sample does not conform to the NHTSA recommended age distribution and the data was collected under real driving conditions as opposed to the specified simulation conditions.

http://agelab.mit.edu/files/MIT_AgeLab_White_Paper_2013-18A_(Voice_Interfaces).pdf

Driving Performance

- Speed
- Standard deviation of speed
- Steering wheel reversal rate
- Hard braking

Is my car really a car ?

- *“She (Galaxy) doesn’t like my voice”*
- *« Elle (Galaxy) n’aime pas ma voix. »*

Discussion

- Limitations

- Eyes Free ?

- Only one car model ?

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Task Analysis of Manual Phone-Dialling in Nine Production Vehicles

Martin Lavallière, B. Mehler, J. Lee, L. Angell, B. Seppelt, and B. Reimer

- OEM race to implement integrated cellular technology into the vehicle
- Growing body of research suggests links between increased use of technology and unsafe driving (NHTSA, 2015)
- Human-Machine Interfaces (HMIs)
  - Lists, hierarchical menus and multitouch controls
  - Likely impact both the duration and cognitive load associated with their use

Objectives

- Three American vehicles, three European vehicles, and three Asian vehicles were selected and assessed to provide a range comparisons across manufacturers from different regions of the world.

- Moreover, we extend Reagan and Kidd's methodology by introducing a second, more difficult dialing task that included contact with multiple numbers
  - home, business, or cell etc. for a given contact.

Reagan and Kidd (2013)

- Hierarchical task structure method to examine current implementations of a standardized, manual cell phone dialing task
  - Reimer et al. 2013

Methods : Vehicules

- European
  - 2014 Mercedes Benz CLA250; 2014 BMW X5; 2013 Volvo XC60
- Asian
  - 2014 Hyundai Santa Fe; 2014 Toyota Highlander; 2014 Mazda 3
- American
  - 2013 Chevrolet Equinox; 2014 Jeep Grand Cherokee; 2010 Lincoln MKS

Methods : the dialing task

- Trained researcher performed the same task in all 9 vehicules
- Cellphone linked to the vehicle interface using Bluetooth© conenction
- The Easy and the Hard task (Mehler et al. 2013)
  - Easy : one possible entry (i.e. 'Call Mary Sanders.')
  - Hard : multiple listings (i.e. 'Call Frank Scott at Work.').
- Visual-manual inputs, or operations using the vehicle's integrated interface were summed as either "press" or "rotate" operations (where a press could be depression of a physical button or touching a virtual button on a screen)
- Error-free

Results
All vehicules

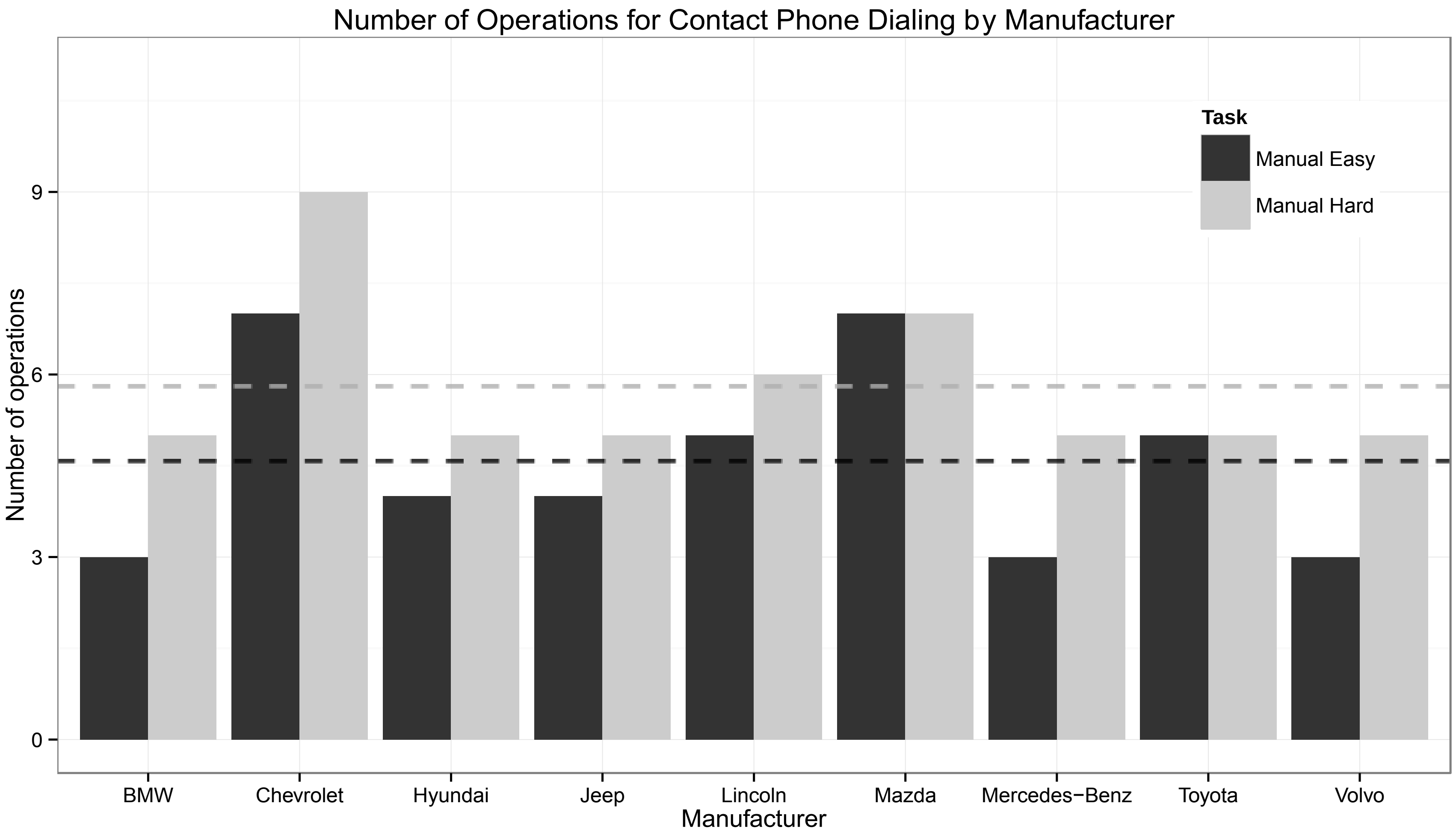

Figure 1. Number of operations for contact phone dialing by vehicle and by task difficulty. *The black dotted line represents the average number of operations for the easy dialing task whereas the gray dotted line represents the hard dialing task.*

Discussion

- Variability across manufacturer
  - Easy vs Hard

- Trained researcher and parked vs Lay-driver on-road
- Multiple ways of entering a contact's phone number
  - typing the contact's name or inputting a 10-digit phone number
- "dead-end" situation using these types of interface

- Previous research on voice-dialing tasks (Reagan & Kidd, 2013) has found verification steps of in-vehicle tasks can reduce errors, but may increase working memory load.
  - One shot entry vs multiple step approval

- Task completion time or glances off-road to the HMI elements

Conclusion

- Better understanding of driving behaviours
- There is no perfect interface
- Human Machine Interface Optimisation
- What is ahead of us ?

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Merci
Questions

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Liens d'intérêts

- http://agelab.mit.edu/files/MIT_AgeLab_White_Paper_2013-18A_(Voice_Interfaces).pdf

- http://agelab.mit.edu/files/MIT_AgeLab_Technical_Report_2013-17A_(Voice%20Interfaces).pdf

- http://agelab.mit.edu/files/MIT_AgeLab_Technical_Report_2013-17A_Appendix_(Voice%20Interfaces).pdf

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