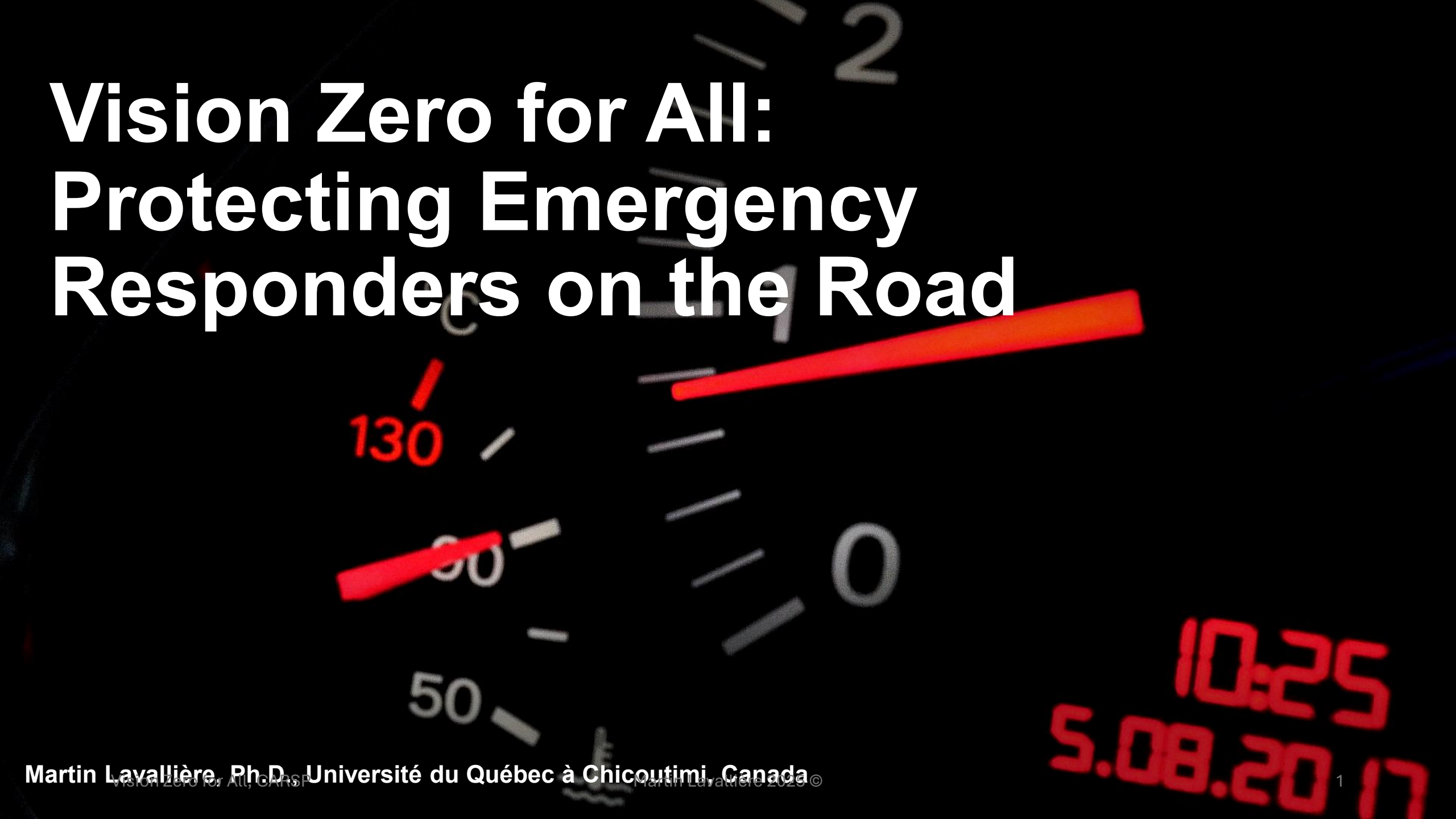
Vision Zero for All: Protecting Emergency Responders on the Road



Martin Lavallière, Ph.D., Université du Québec à Chicoutimi, Canada

Presentation Description

- Emergency responders, police officers, firefighters, and paramedics, regularly work in high-risk roadside environments where a single moment of inattention from drivers can have fatal consequences.
  - This webinar explores how the **Vision Zero framework**, which aims to eliminate traffic fatalities and serious injuries, can be extended to include those who protect and serve on our roads.
- Participants will gain insights into the **unique exposure risks** faced by emergency responders and how **systemic safety principles**—such as safe road design, appropriate vehicle technology, intelligent traffic control, and behavioral change strategies—can mitigate these dangers.
  - Case studies and data from various jurisdictions will illustrate **effective interventions**, including enhanced “Move Over” laws, improved roadside scene management, visibility standards, and driver education initiatives and curriculum from initial training to continuing education.
- The session will also emphasize the importance of **interdisciplinary collaboration** among transportation agencies, emergency services, and policymakers to build a road environment that safeguards both the public and responders.
  - Attendees will leave with a clearer understanding of how **Vision Zero principles** can be operationalized to create safer, more resilient response systems for everyone on the road.

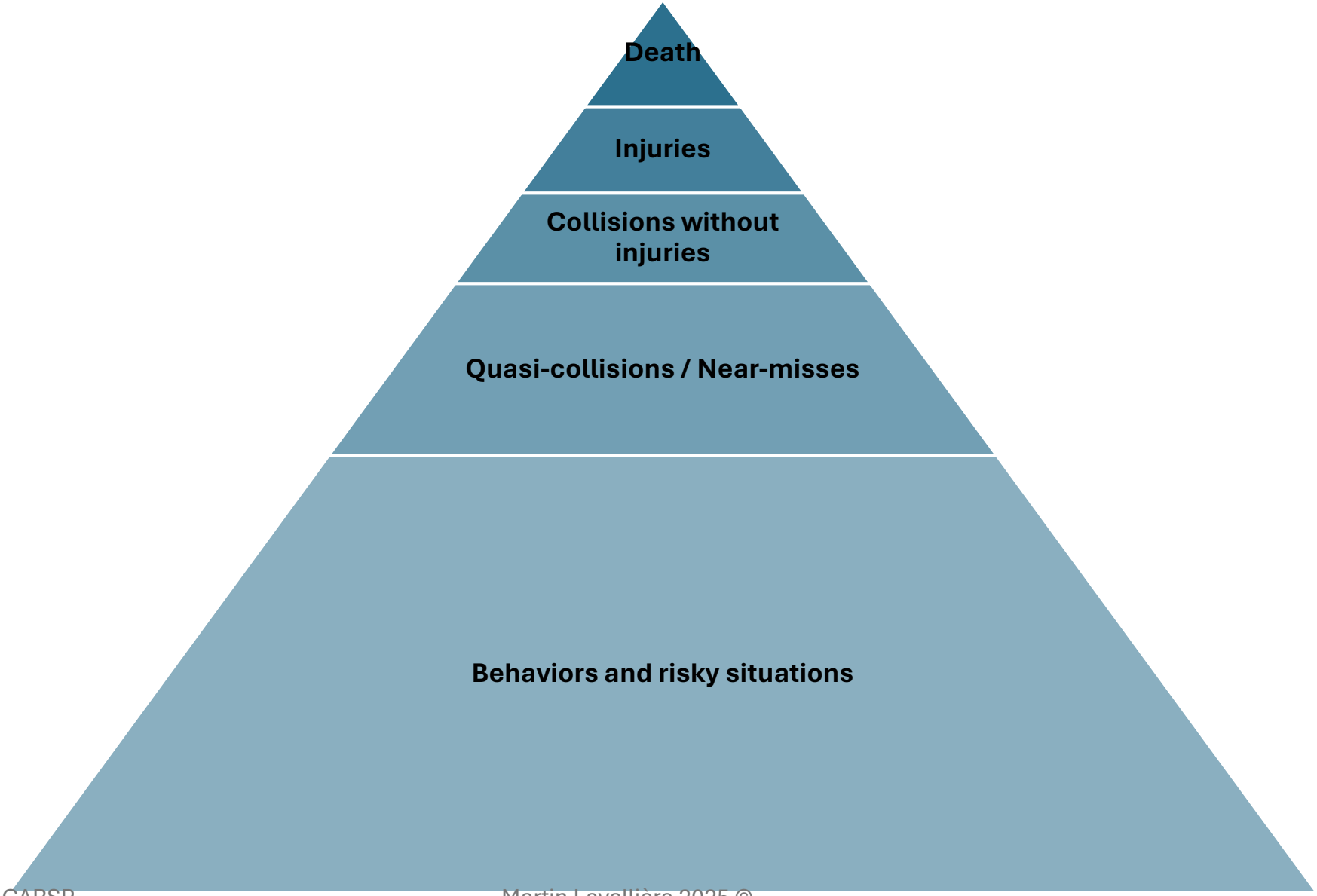
Collaborators

- **Jerome Range, B.Sc., M.Sc. (c), Université du Québec à Chicoutimi, Canada**
- **Virginie Tutenuit, M.Sc., Université du Québec à Chicoutimi, Canada**
- **Milad Delavary, Ph.d., Researcher, TIRF**
- **Hector Ignacio Castellucci, Ph.D., Universidad Valparaíso, Chile**
- **Mathieu Tremblay, Ph.D., Université du Québec à Rimouski, Canada.**
- **Isabelle Bouchard, M.Sc., Chercheuse principale de Collège, Responsable du Centre interdisciplinaire de simulations en santé, Cégep de Chicoutimi**
- **Manon Tremblay, Coordonnatrice SPU, Cégep de Chicoutimi, Paramédic soins primaires**

First Responders and Road Safety

- Who are they
  - Bevan et al. 2022
- Their work
- Their safety
  - Hsiao et al. 2018
- Their risks
  - Delavary et al.
  - Lavallière et al.

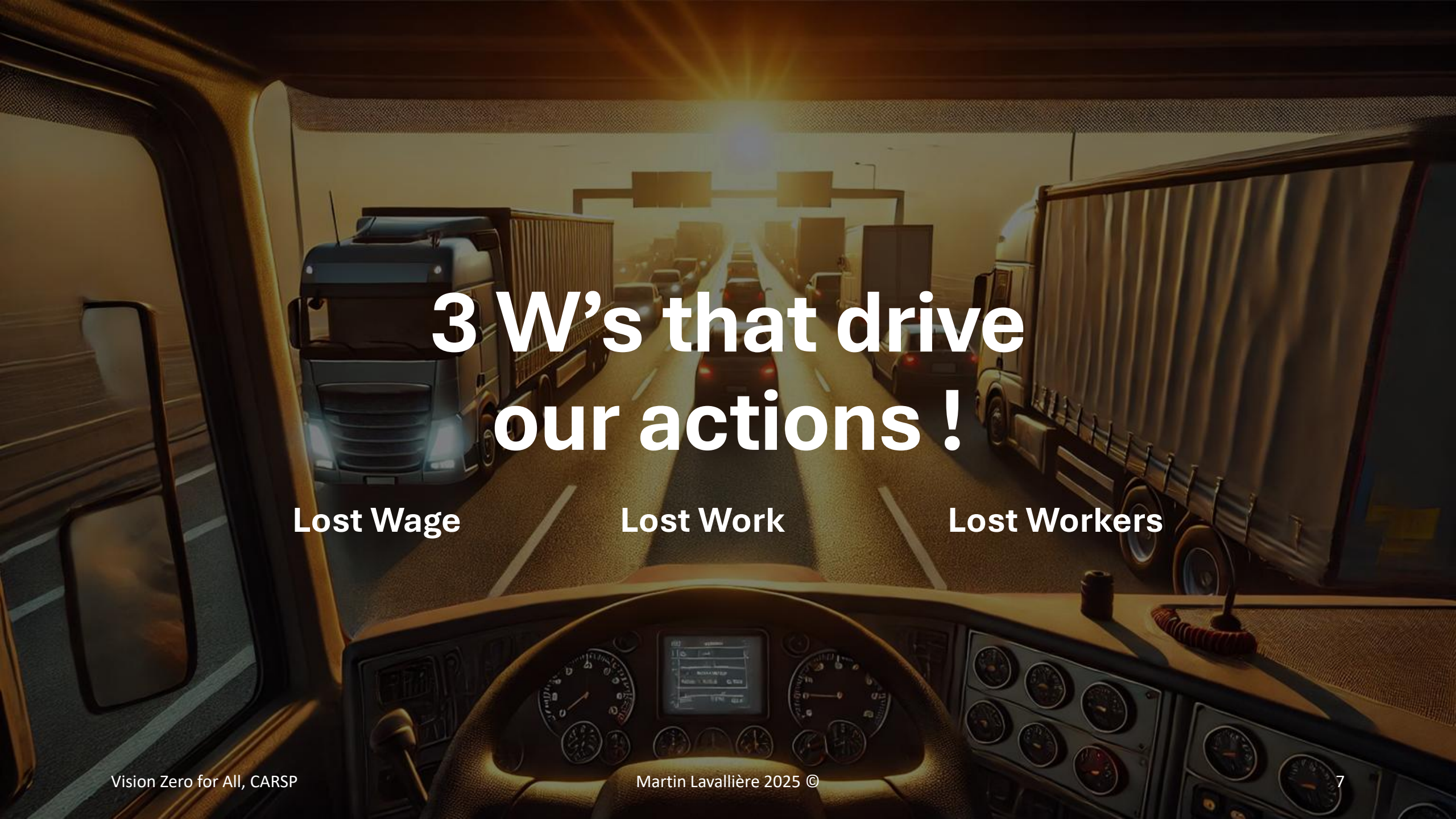
Pyramid of risks : work related collisions



Emergency vehicule use

- The first responder:
  - Patrol
  - Receives an emergency call
  - **Drive to the scene**
  - Answers the call (varies depending on the profession)
  - **Drive to …hospital, antoher call, etc.**
  - Returns to their workplace (varies depending on the profession)

- From 2000-2008 in Québec, 10% of collisions involved first responders. The main scenario was composed of police officers at intersections on Saturdays
  - (IRSST, 2016).
  - Among these collisions, running a red light or a stop sign (32%) and not wearing a seatbelt (20%) are most frequent.
- Consistent with a driving-simulation study in paramedic students evaluating stress while driving as a first responder
  - **Driving Me Crazy: The effects of stress on the driving abilities of paramedic students.**
    - (Duncliffe et al., 2018)



3 W's that drive our actions !

Lost Wage **Lost Work** **Lost Workers**

Systems

Post Trauma

Road Crashes & Trauma

Systemic Failures

Road Speed
Tech Vehicle
Care Road User

Road Safety Management

?

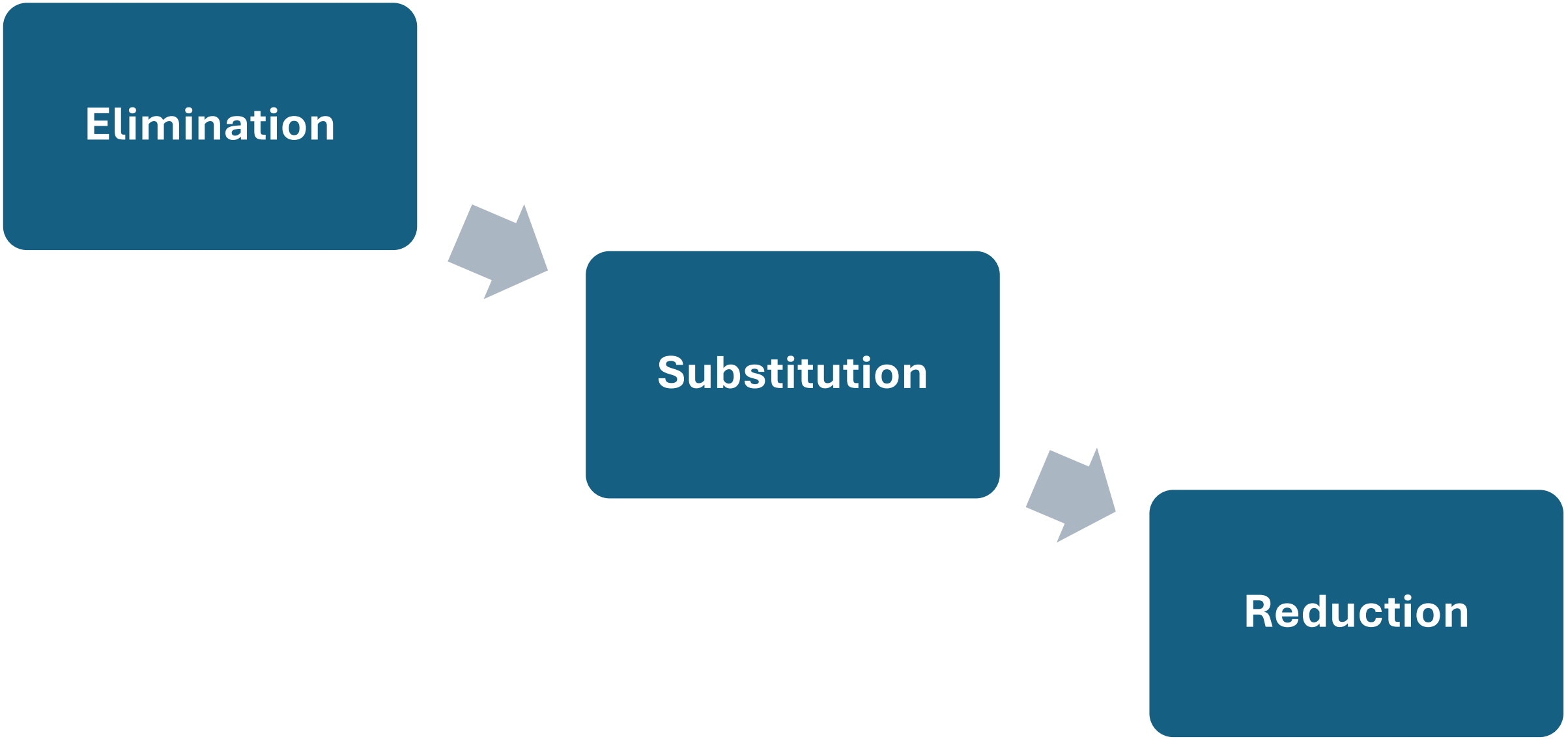
Road transport System

Network Land Use Rules & Standards
Operations Assets Travel Demand Vision

Socio-Econo-Cultural

Poverty Inequity Fuel Prices Mobility Options
Norms Culture Lifestyle Population

HEA CONSULTING

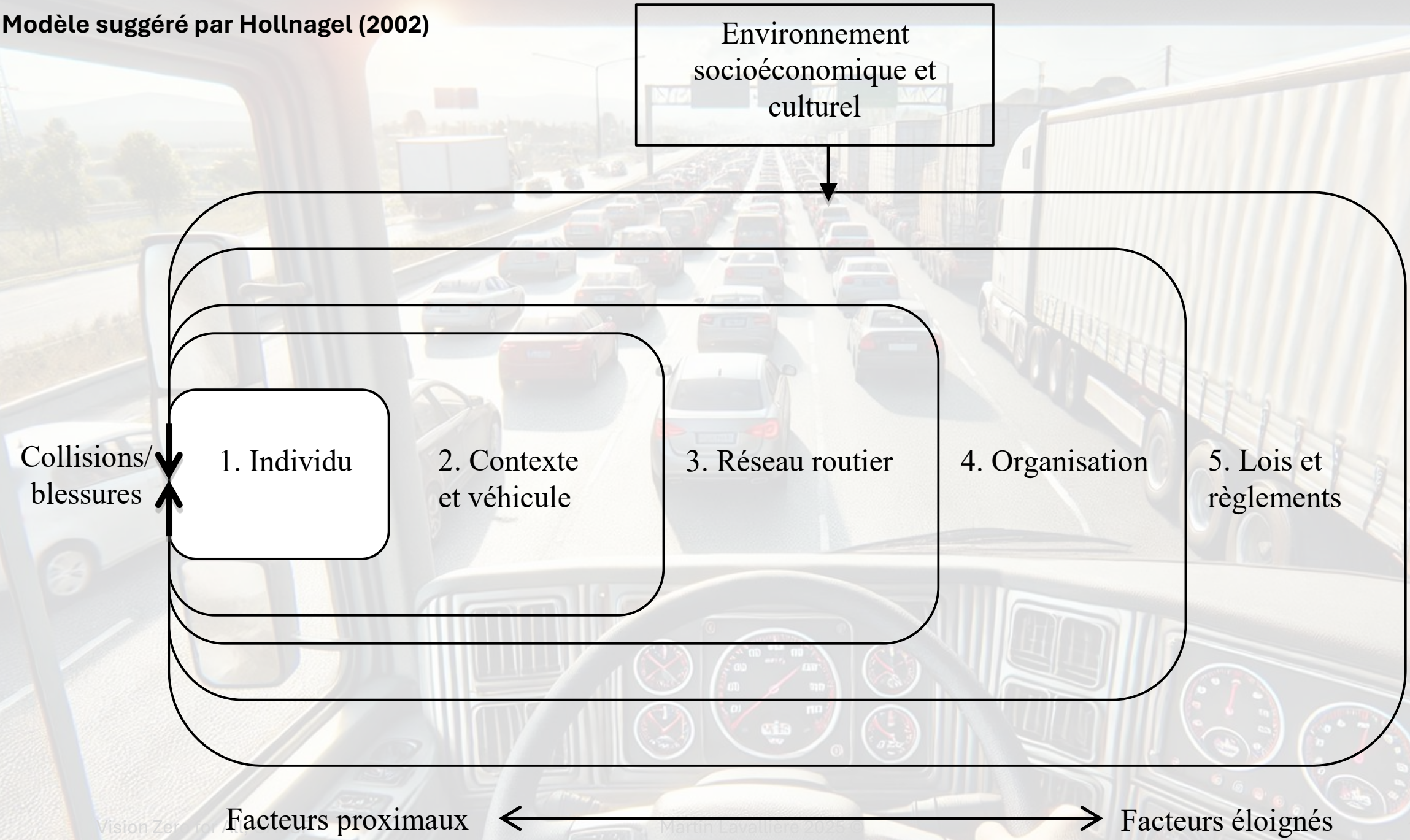


Risks to driving and health

What route can be taken to limit collisions in first responders?

Unlike other drivers, first responders cannot implement strategic measures to avoid dangerous situations due to working context, weather and road conditions, time pressure and having to choose optimal routes rather than safer routes.

Modèle suggéré par Hollnagel (2002)



The Five “I” Framework of crash investigation: Linking investigation practices to safety reform

From one to multiple collisions

- Analyses
- Trends
- Patterns

https://www.sciencedirect.com/science/article/pii/S0001457523003433?ref=pdf_download&fr=RR-2&rr=9a103deddda6a2ba#f0010

FIVE I Framework

GUIDING PRINCIPLES FOR PREVENTION-FOCUSED CRASH INVESTIGATIONS

The **Five I Framework** outlines principles for practical, prevention-focused crash investigations, leading to more robust and ethical injury prevention and transportation policy. It aligns with public health, the Safe System Approach, and Vision Zero, highlighting the importance of post-crash investigations as a systematic component of an overall road safety strategy, as recommended in the Global Plan for the Decade of Action for Road Safety 2021-2030 (Dinh-Zarr, Shuey, and Mooren 2023).

IN-DEPTH

In-depth, multidisciplinary investigations provide the most accurate, complete safety data and analysis. This increases equity by ensuring policymaking is based on complete, unbiased information.

- ✓ Investigators create a complete and detailed timeline surrounding a crash.
- ✓ Risk factors (pre-crash, crash, post-crash) and similarities to previous crashes are identified and analysed.

IMPARTIAL

Impartial investigators collect and analyze data and impartial experts make safety recommendations.

- ✓ Investigators must recuse themselves from an investigation if they have financial, personal, or other ties, to avoid biased assessments.
- ✓ Technical information from external sources is examined neutrally and scientifically.
- ✓ Impartial expert panels review and endorse/revise/clarify investigation results and safety recommendations.

IMMEDIATE

Immediate (as soon as practical) investigations are coupled with prompt data collection and analysis.

- ✓ Investigators secure and analyze the scene, interview witnesses, collect data (especially perishable data). They may also inform* families/survivors/victims and, as appropriate, others such as those providing technical information, public officials, media, and the public.
- ✓ Immediate use of data and prompt, accurate issuance of safety recommendations leads to critical actions for timely safety reform.

INDEPENDENT

Independent organizations have greater credibility because they are not obliged to reflect the views of outside entities.

- ✓ Safety recommendations are viewed as more trustworthy if they originate from an independent body or are endorsed by an independent source.
- ✓ If investigative agencies are not organizationally or financially independent of governments or sponsors, independent oversight is essential at a minimum.

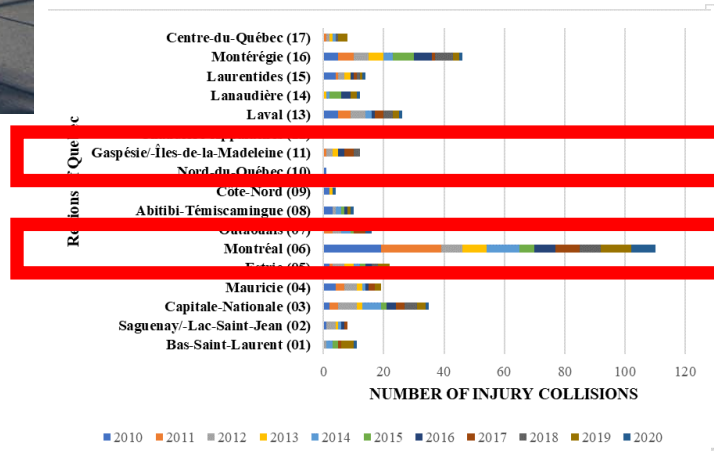
INJURY PREVENTION

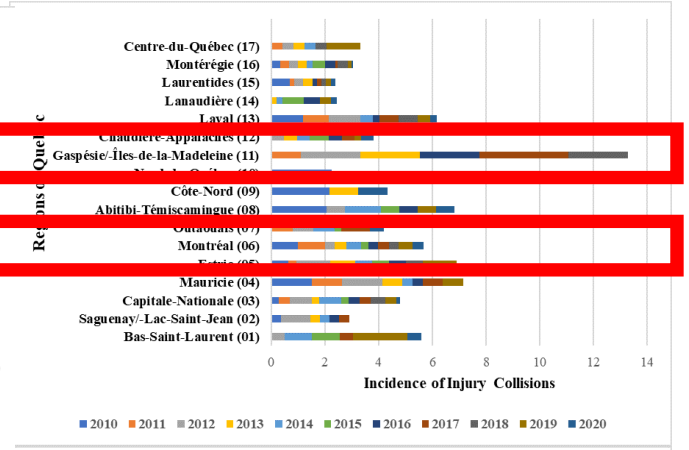
Injury prevention must be the primary purpose of a safety investigation. It must be of paramount importance over prosecution, retribution, or liability.

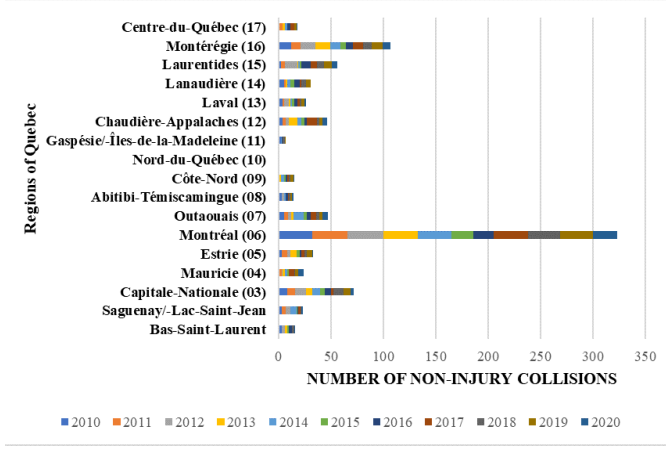
- ✓ Identify system factors throughout the timeline that could have prevented the crash or increased survivability.
- ✓ Use the results of the in-depth, impartial, and immediate investigation, with independent oversight, to make practical recommendations for injury prevention policy.

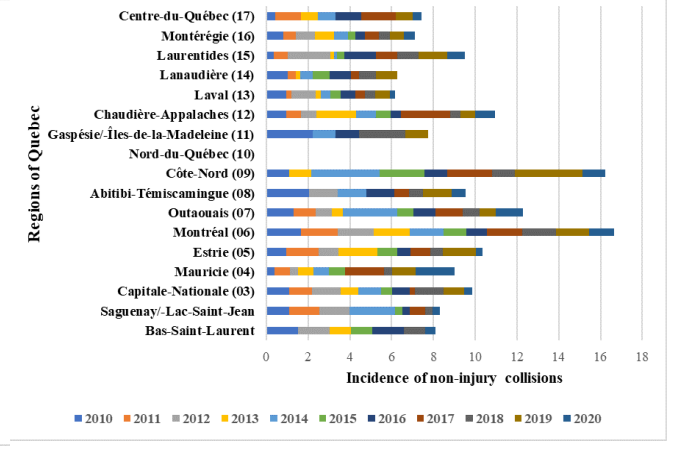
*A sixth "I", informing family members and the public, may be considered external to the investigation, but it is an ethical imperative (and a legal requirement in some jurisdictions) and may assist in obtaining more accurate and complete information.

The authors thank Jennifer Hall of the Traffic Injury Research Foundation for her contributions to the infographic.

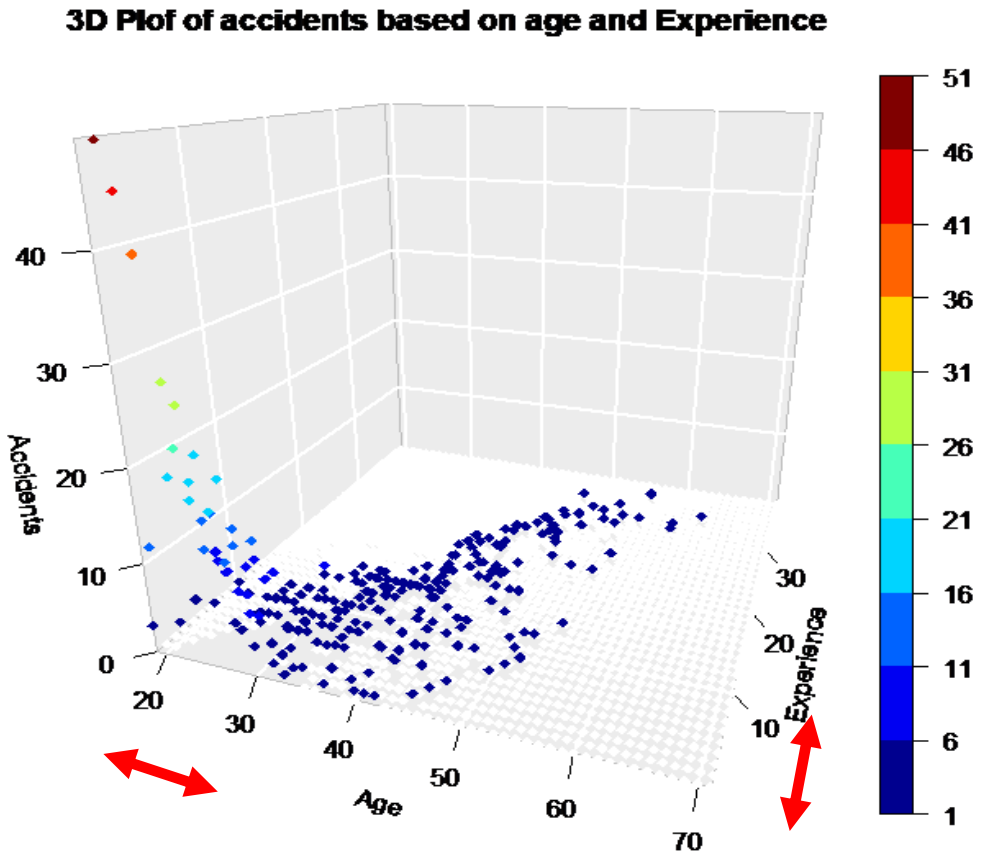


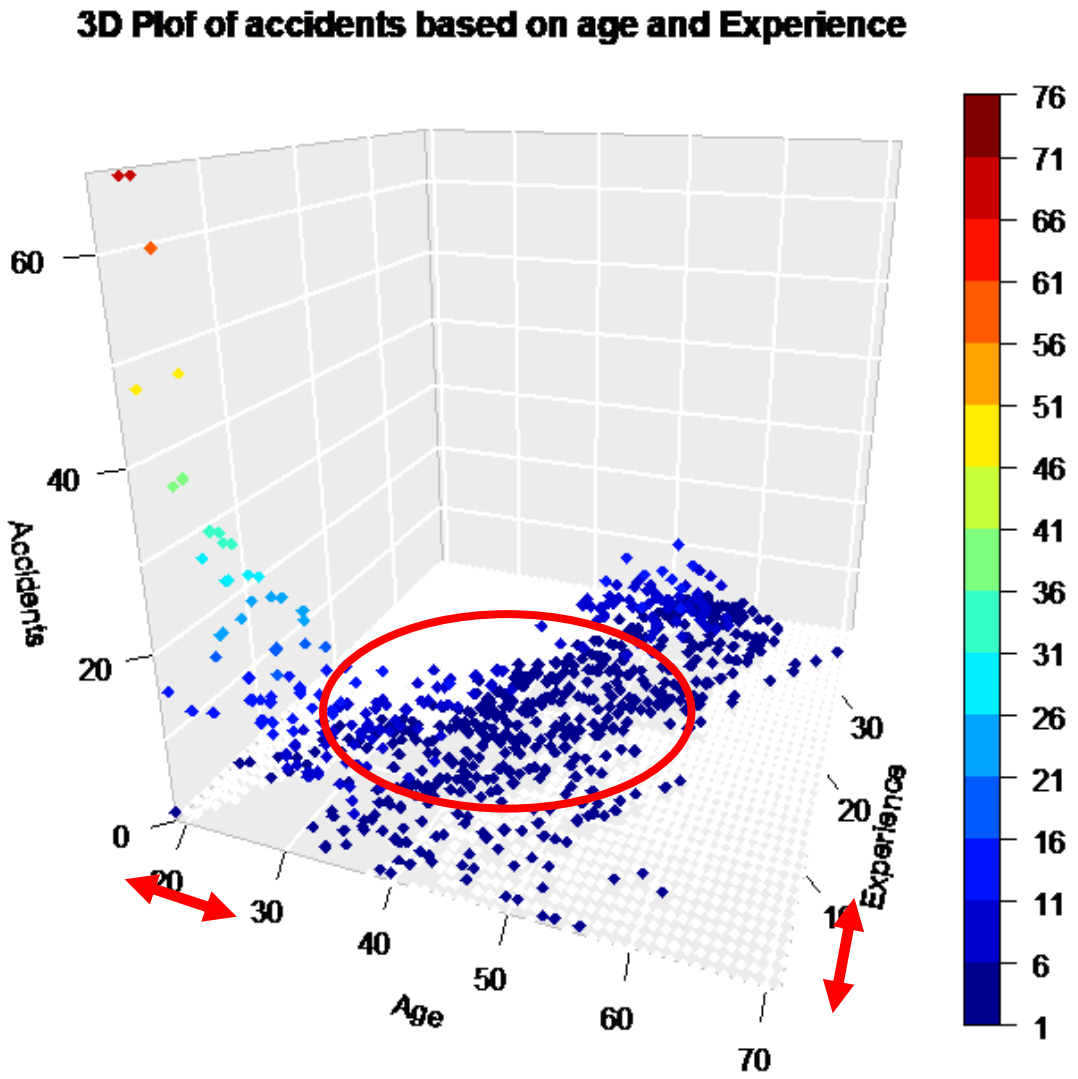






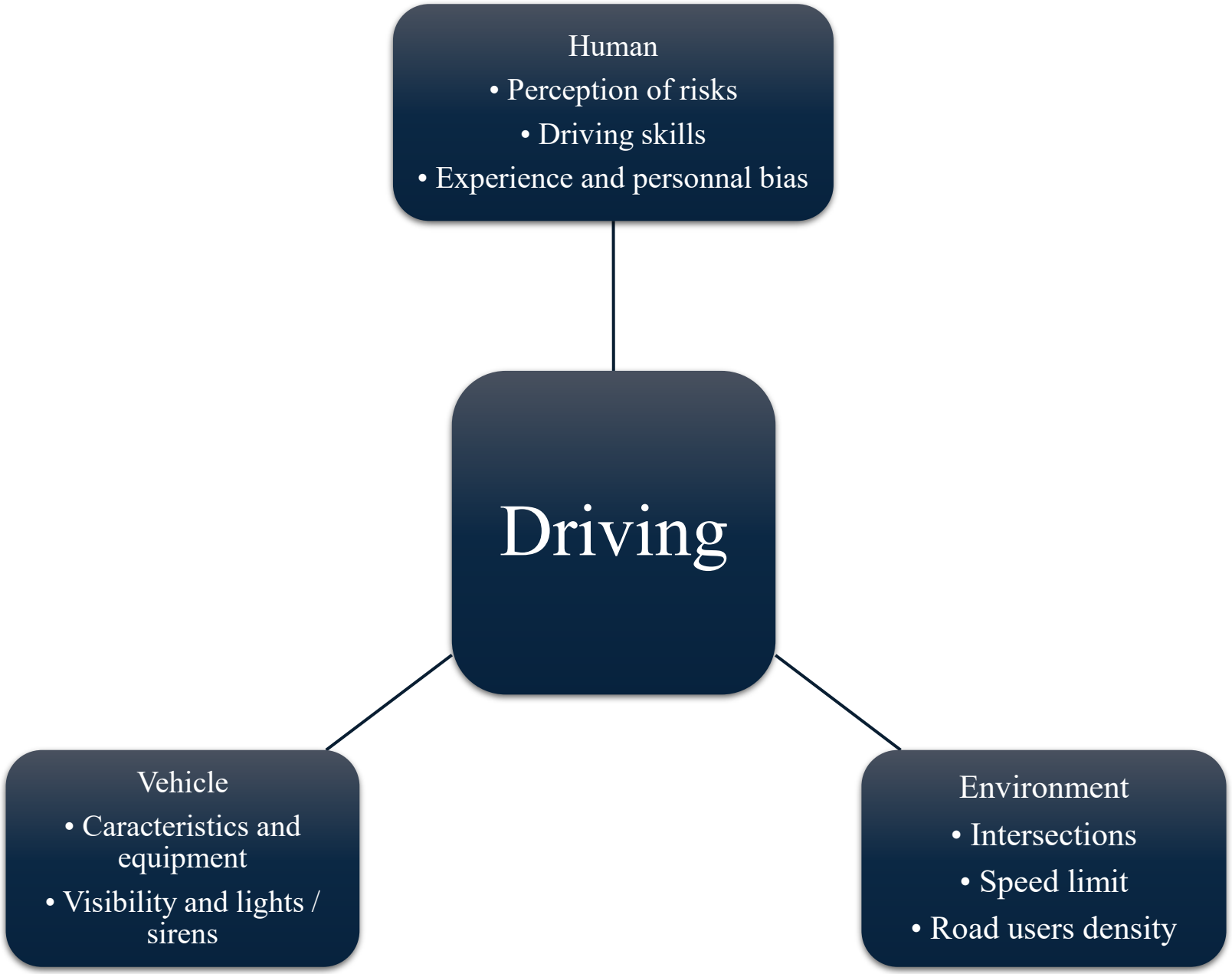
Delavary, M., Tremblay, M., & Lavallière, M. (In-review). Work-Related Collisions Involving Paramedics in Quebec (Canada): An Analysis of Contributing Factors and Policy Implications. *International Journal of Occupational Safety and Ergonomics*.





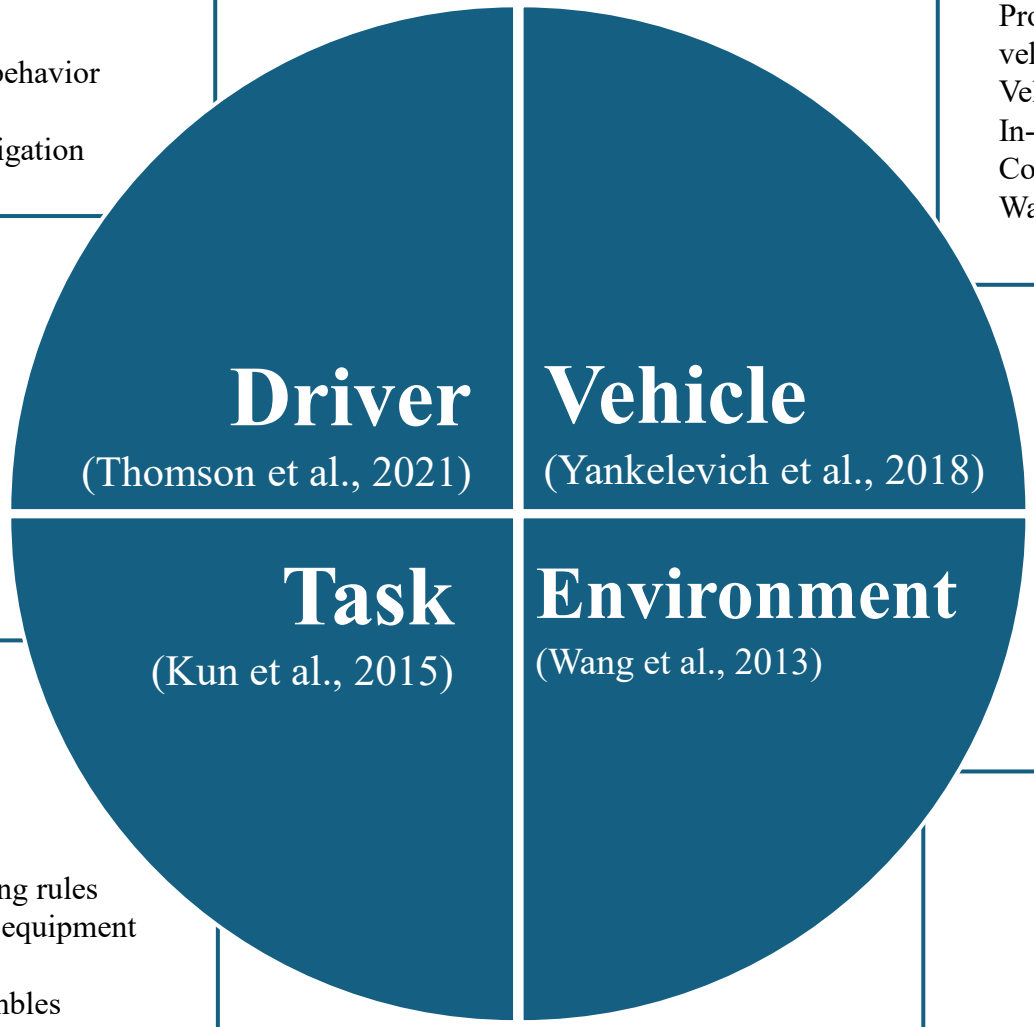
Delavary, M., Tremblay, M., & Lavallière, M. (2024). Navigating paramedics' safety: unraveling factors in emergency service vehicle incidents. *International Journal of Paramedicine*, 5, 82-102. doi: 10.56068/MHCE4982

What we expect from them ?



Main risk factors in first responders

(Hsiao et al., 2018)



Individual differences
Driver skills, experience, behavior and risk perception
Control, guidance and navigation

Problems related to the vehicle
Vehicle characteristics
In-vehicle equipment
Conspicuity
Warning signals

Time pressure
Secondary-task demands
- Speeding
- Necessary conversing
- Monitoring messages
- Violating normal driving rules
- Activating emergency equipment

Prognostic failure
Personal protective ensembles
Long shift hours
Driving under emotions

Intersections
Road design
Traffic signals
Road speed limit
Light conditions
Weather
Pedestrian density

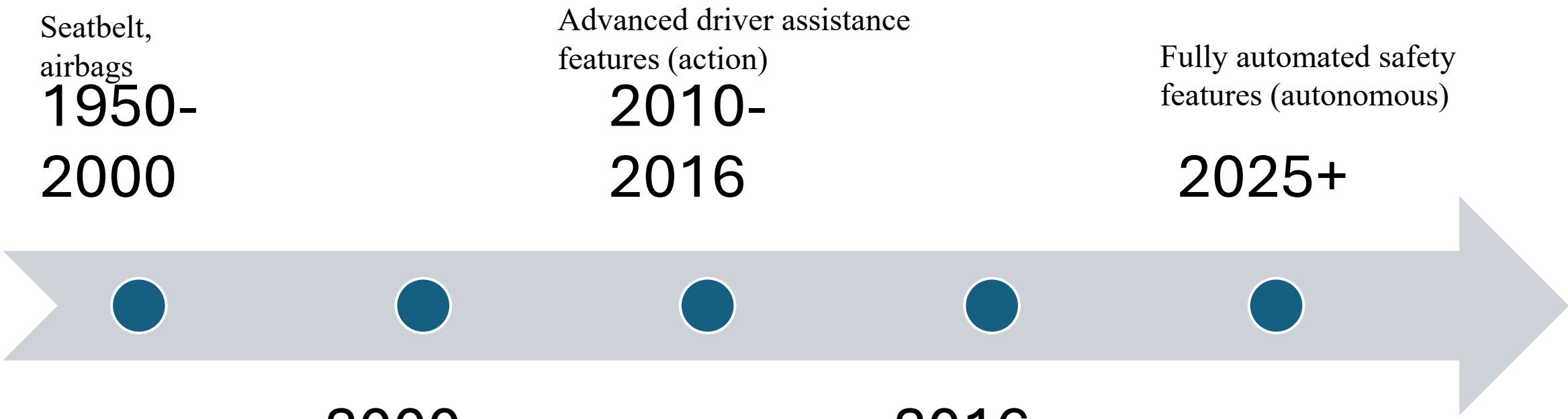
Environment

- Road users' behaviour influence how efficient emergency vehicles navigate through traffic
  - Alonso et al., 2018
  - Frequent complaints of emergency respondants in focus group

- Some studies have approached toward potential solutions with methods to notify road users such as approaching emergency vehicles notifications
  - Lidestam et al., 2020; Hannoun et al., 2018

Five Eras of Safety

United States National Highway Traffic Safety Administration (NHTSA)



Driving Performance and Secondary Tasks

Secondary task

- All first responders have various tasks outside of driving
  - Kun et al., 2015
    - Speeding and/or « Violating » normal driving rules
    - Necessary conversing
    - Monitoring messages
    - Activating emergency equipment : lights and sirens
    - Transporting injured patients (specifically emergency medical vehicles)
    - About one third of driving time is spent with in-vehicle devices (specifically in police officers) (Zahabi et al., 2020)
      - If driving pursuits are added to the equation, a high mental workload can cause reduction in accuracy and driving performance due to secondary tasks
        - Zahabi et al., 2023
        - Tutenuit et al. 2025

Secondary task

- There's evidence of secondary tasks impacting police officer injury rates (Servino 2013; Liu & Donmez, 2011) as well as emergency medical vehicles and firefighters (Becker et al., 2003; Delavary et al., 2023)
- Police officers
  - Often reluctant to wear seatbelts due to perceived interference time with firearm withdrawals and swift exits
    - Oron-Gilad et al., 2005
  - While they have training involving driving safety, there isn't clear evidence showing that safe driving is maintained when working
    - Filtness et al., 2013
  - Mobile data terminals are distracting (Zahabi & Kaber, 2018) yet improve productivity (Zahabi et al., 2020)
    - In a single crew patrol car, they can compromise road safety (Hampton & Langham M., 2005)

Hazard Perceptions

Time pressure

- Emergency medical vehicles must mobilise to scenes in a rapid manner
  - Custalow & Gravitz, 2004

- Time pressure is a major issues that police officers face
  - Hutson et al., 2007; Rivara & Mack, 2004

- Firefighters also have to deal with time pressure
  - Clarke & Zak, 1999

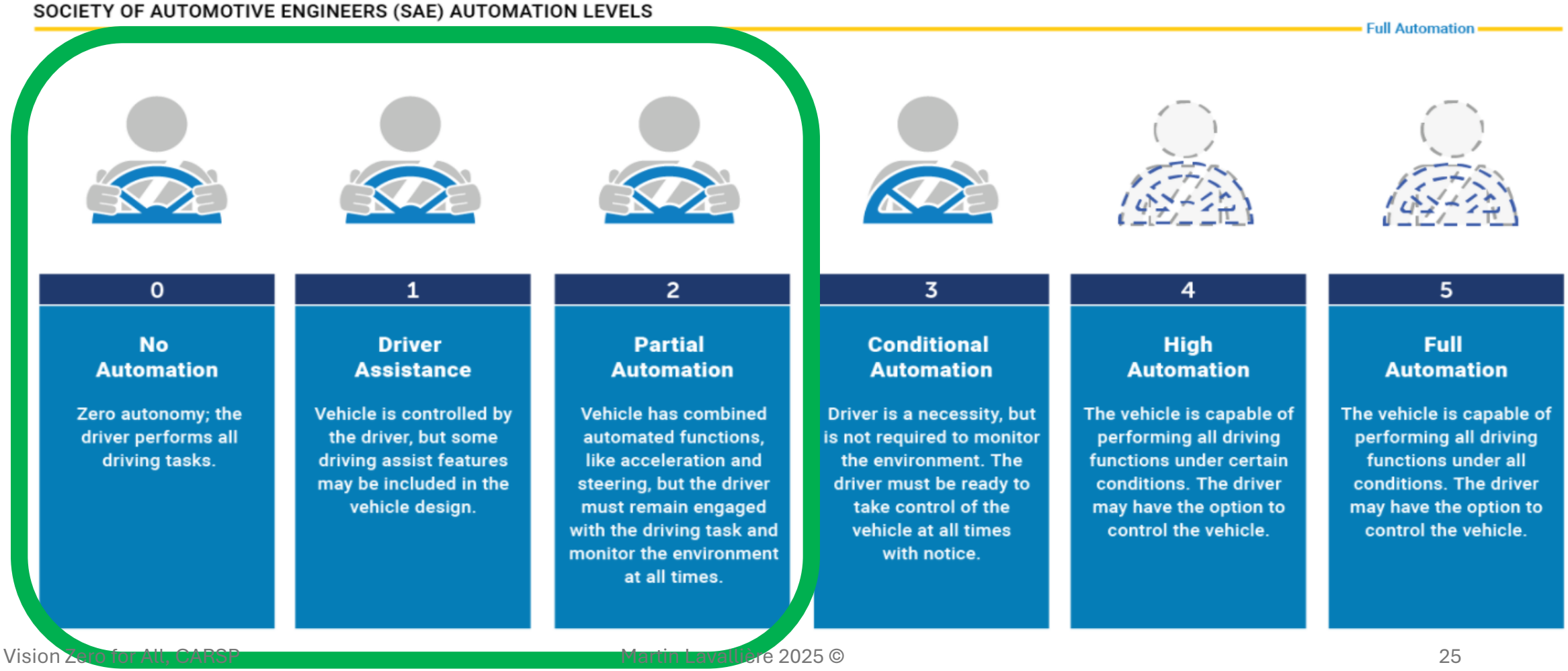
- Prossecutions when collisions occur

Task changes in humans

- Humans are not built to complete tasks requiring vigilance and sustained attention over long periods of time
    - Warm et al., 2008
- Automation relieves drivers from otherwise manual tasks
    - Wiczorek & Manzey, 2014
- Initial objective for advanced safety features: for drivers to spend more time focusing on potential hazards around the vehicle when driving
    - Mennie et al., 2007
- Moving further in time to partially automated safety features, a new concern appeared of drivers putting too much faith into technology and shifting attention elsewhere
    - Naujoks et al., 2016

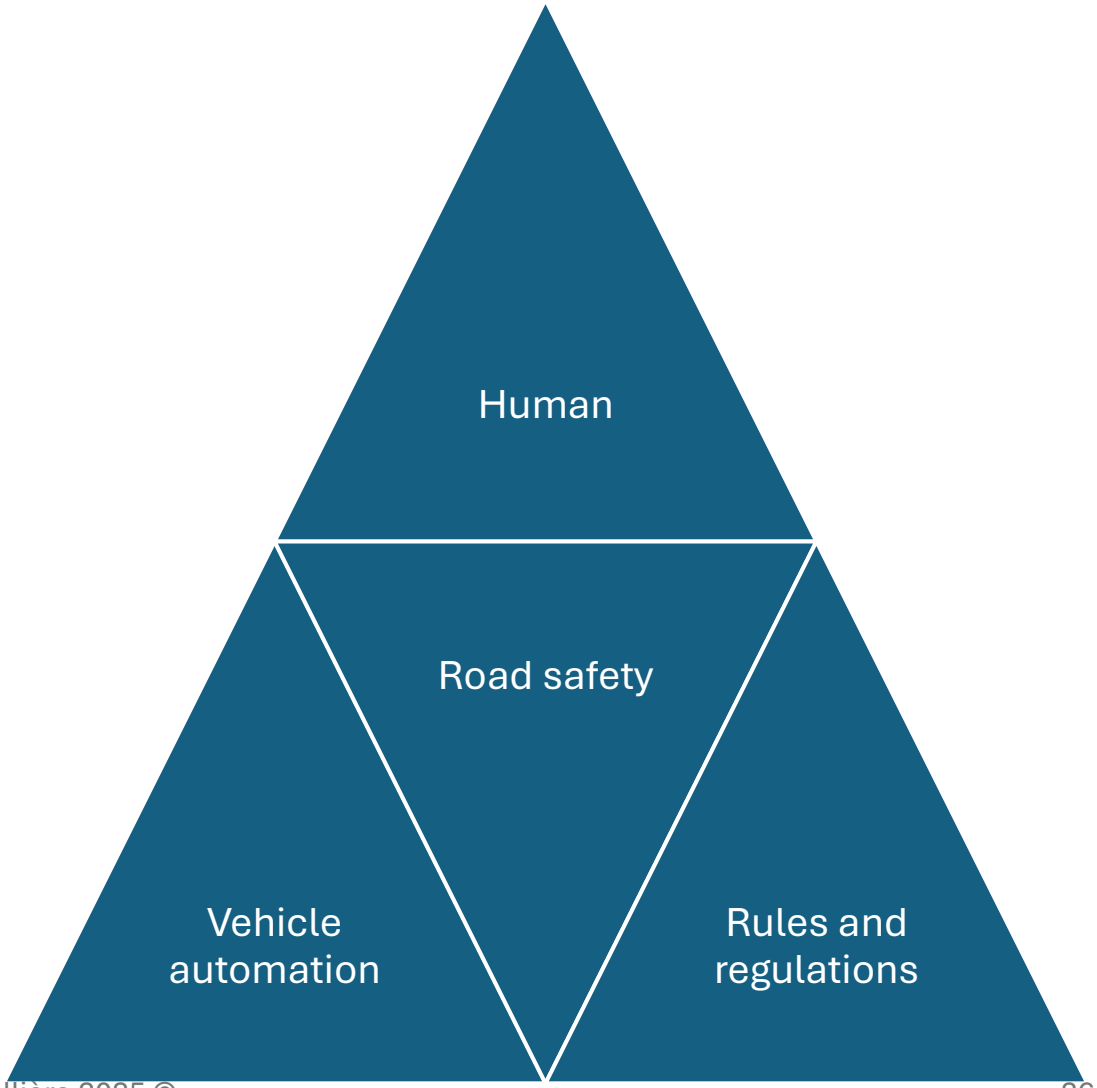
Technological Interventions

Aide à la conduite automobile, passive ou active
(Advanced driver-assistance systems ADAS)



Assistive driving technologies

- Vehicle automation
  - Massive evolution since 2016
- Rules and regulations
  - Reconsideration of regulations and responsibilities in drivers (Barabás et al., 2017)
- Human
  - To what point should humans be taken out of the driving equation?
  - How should this technology be used?



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Behavior change associated with using partial automation among three samples of drivers during a 4-week field trial

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ARTICLE INFO

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Visual-manual distraction
Complacency
Inattention

ABSTRACT

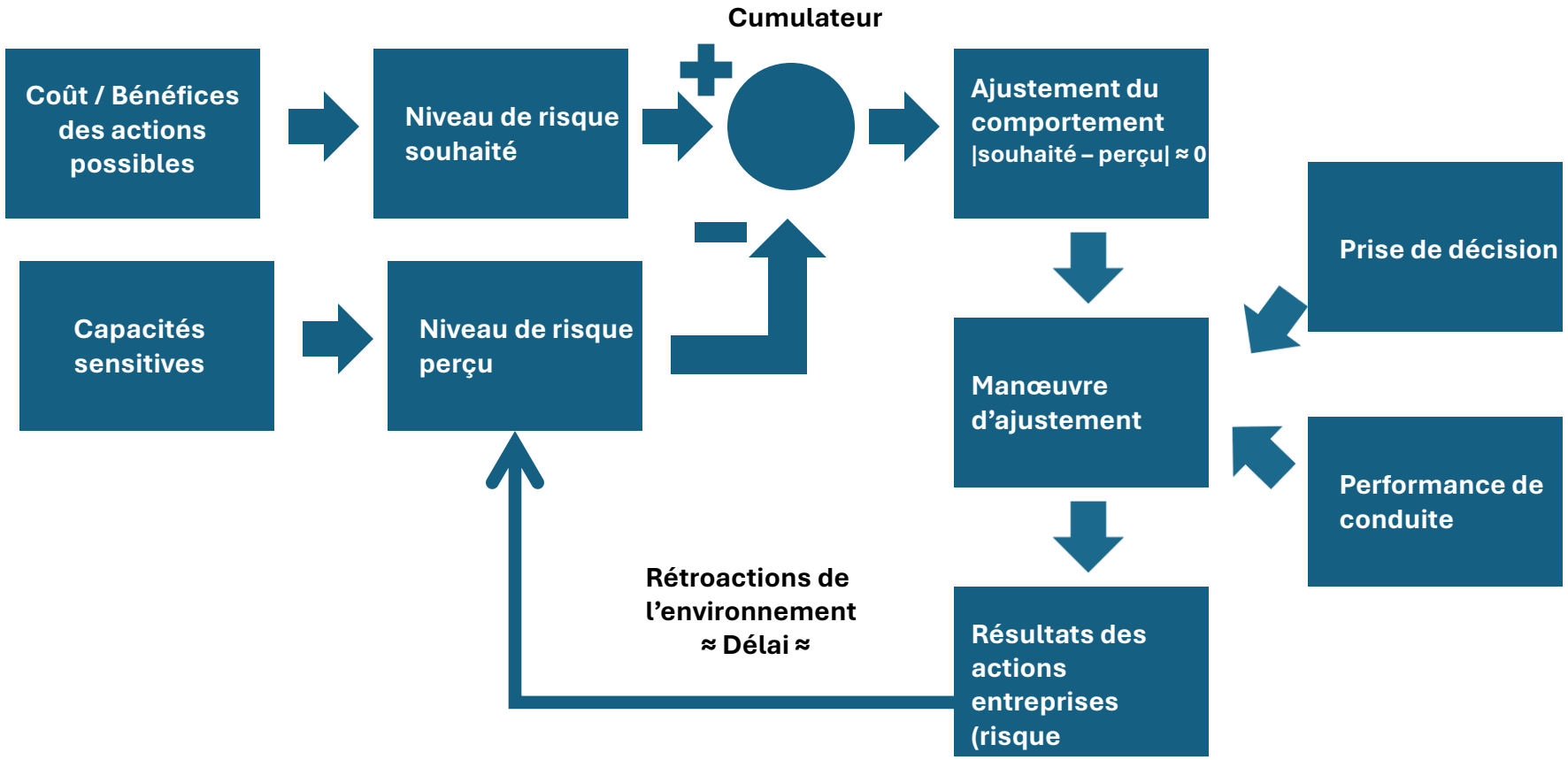
Introduction: Partial automation is still evolving. There is need to understand how behavior changes over time as drivers develop familiarity with the technology. In Reagan et al. (2021; Transportation Research Part F, 82), volunteers driving a Volvo S90 with adaptive cruise control (ACC) and Pilot Assist, which couples ACC and continuous lane centering, had higher likelihood of visual-manual disengagement when using Pilot Assist in the second portion of a 4-week field trial compared with manual driving or when driving with Pilot Assist in the first portion. *Method:* We used the same analytical approach as Reagan et al. with three samples of drivers ($n_A = 10$, $n_B = 10$, $n_C = 9$). We estimated the odds of observing visual-manual distractions or both hands off the wheel

Table 1
Percentage of time behavior was observed when driving on limited-at speeds over 25 mph.

Behavior	Group A	Group B
Holding cellphone	1.9	0.8
Handheld cellphone conversation	0.3	1.7
Manipulating cellphone	1.1	0.4
Reaching for cellphone	0.2	0.1
Manual center stack interaction	1.3	1.6
Manual interaction with controls on steering wheel	0.7	0.9
Subtotal: Visual-manual cellphone or in-vehicle interface use	**5.4**	**5.5**
Eating or drinking	4.7	2.6
Personal grooming and hygiene	3.0	3.0
Interacting with object	0.3	0.7
Reaching for object	0.2	0.1
Reading or writing	0.0	0.0
Subtotal: Traditional visual-manual tasks	**8.1**	**6.4**
Total: Visual-manual tasks	**13.4**	**11.8**
Both hands off steering wheel	0.6	0.1
Hands-free voice conversation	1.4	0.3
Voice-based in-vehicle interface	0.4	0.1
Other tasks (e.g., passenger interaction, singing)	14.8	6.4

Note. Bolded values indicate aggregation across secondary behavi
individual values may not equal aggregated totals, as drivers may h
in multiple behaviors at once.

Risk homeostasis (adapted from Wilde)



Zzzzzzz

Sommeil (Sleep), Fatigue, Endormissement (Drowziness)

A comprehensive analysis of accidents estimates that fatigue is involved in nearly 22% of serious accidents in Quebec.

www.saaq.gouv.qc.ca/fatigue

Vision Zero for All, CARSP

Driver training and technologies

- Typical routes
  - Collective education and awareness campaigns
- Good routes
  - Practical experience on the road
  - Specific feedback
- Promising avenues
  - Simulation and virtual reality
  - Onboard technologies

Learning-stage of First Responders

List of college-level driving courses

- Paramédic (exemple)
  - Cégep de Chicoutimi
    - **181-530-CH** Utilisation d'une ambulance 1h théorie, 2h pratiques/laboratoire, 1h travail personnel
  - Cégep de Ste-Foy
    - **181-A60-SF** Conduite d'une ambulance en situation d'intervention 1h théorie, 3h pratiques/laboratoire, 2h travail personnel
  - Collège Ahuntsic
    - **181-155-AH** Utilisation d'un véhicule ambulancier 1h théorie, 2h pratiques/laboratoire, 1h travail personnel

- The Police Model
  - Autonomous Driver's License
  - Acquired before driving lessons
- Divergent College Curricula
  - Defensive Driving
- ENPQ
  - Simulator, Patrol, Emergency
- Police Forces

Utilisation d’une ambulance (**181-530-CH**)

- « L’objectif du cours ***Utilisation d'une ambulance*** est d’amener l’étudiant à conduire une ambulance et à utiliser les systèmes de communication radio et informatisés. Il est le seul cours spécifique d’initiation et d’opération du véhicule ambulancier. Les habiletés acquises dans ce cours prépareront l’étudiant à opérer le véhicule ambulancier de façon sécuritaire et efficace en situation d’intervention. »
  - https://grillecours.cegep-chicoutimi.qc.ca/basic.asp?prog=SPU#

- Pas de conduite d’urgence en contexte urbain ou rural

A bad example of curriculum !

181-362-NF	Conduite d'un véhicule ambulancier	Avez-vous toujours rêvé de ne pas respecter les lumières rouges? Les limites de vitesse? Avec le cours de conduite d'un véhicule d'urgence, vous apprendrez comment et pourquoi nous avons le droit de ne pas respecter le code de la sécurité routière. Ce cours vise à développer des principes de base, une attitude et des comportements appropriés lors de la conduite d'un véhicule d'urgence. Tout en se basant sur une conduite préventive et sécuritaire d'une ambulance en situation urgente et non urgente, vous devrez maîtriser différentes conduites, des freinages d'urgence, évitement d'obstacle, stationnement d'un véhicule et aussi ajustement de la conduite en présence d'un bénéficiaire. Ces diverses situations se feront en circuit fermé ainsi qu'en circuit routier avec de vrais véhicules ambulancier.

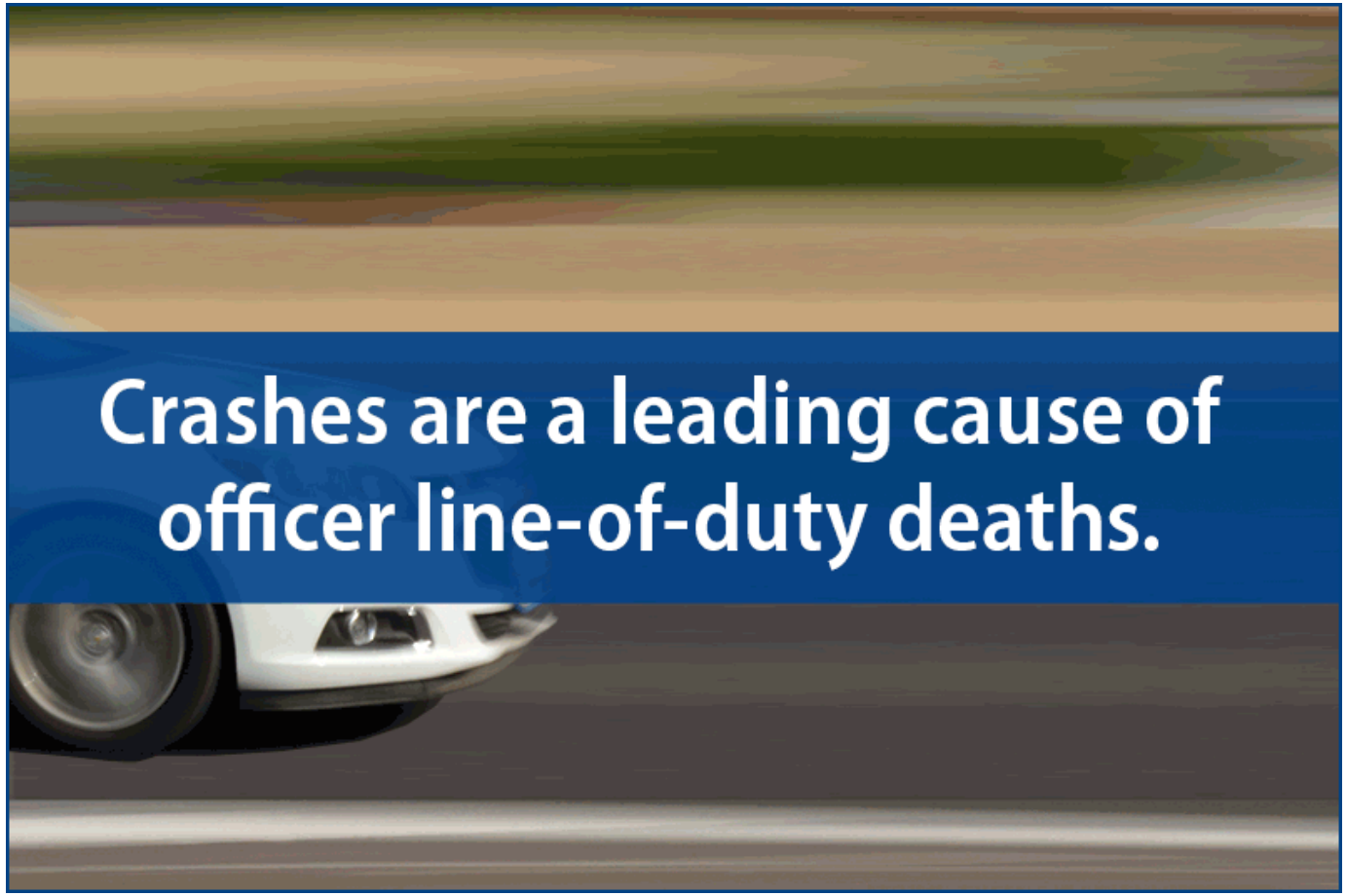
How is a collision perceived in your workplace?

In your opinion, what work environments pose the greatest risk of involvement in a road collision?

In what work context are you most likely to take risks while driving?

Example of a safety campaign

https://www.cdc.gov/niosh/motorvehicle/images/leo_GIF.gif



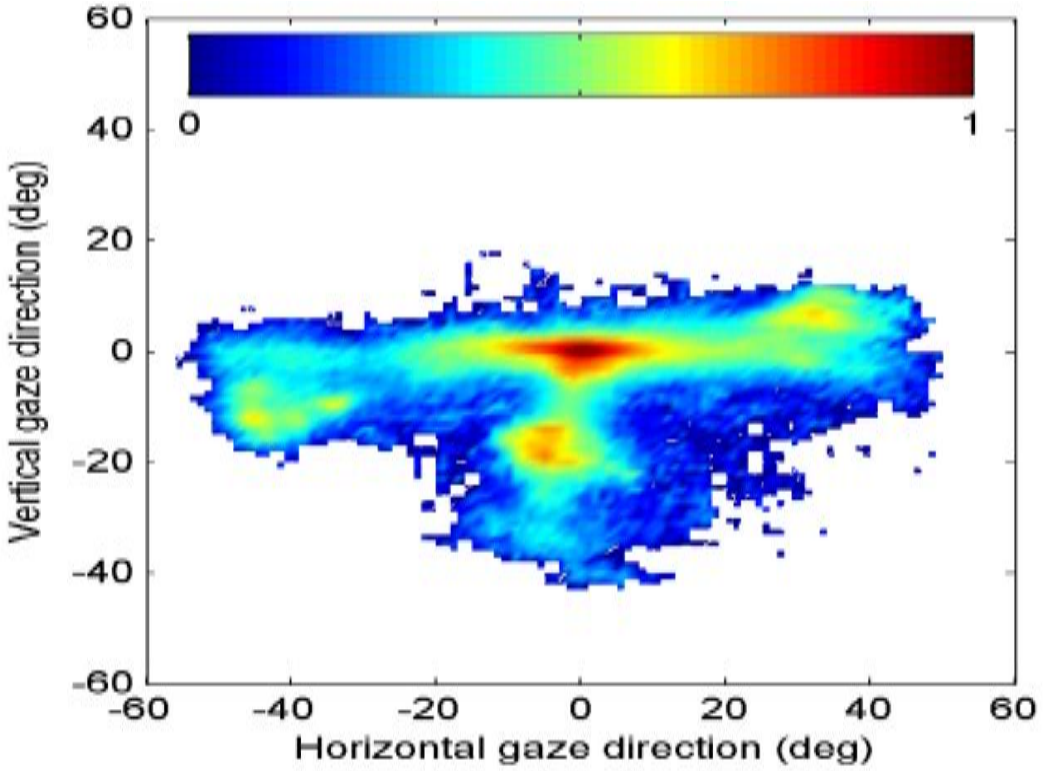
Ergonomie véhiculaire

- **Your posture**
- **Your Vision 360 : ajusting external mirros - CAA-Québec**
  - https://www.youtube.com/watch?app=desktop&v=lZb4BQuNSp4

Move over law

- Physical placement along the road side
- Public’s behaviours
- Automated enforcment

Driving Simulators



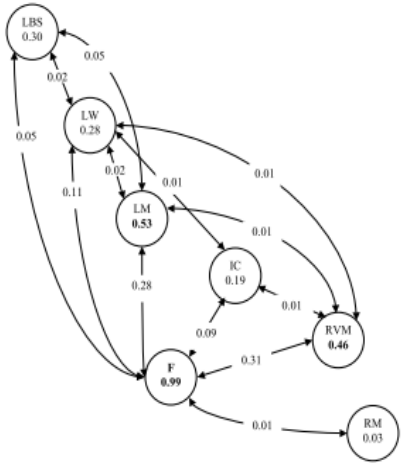
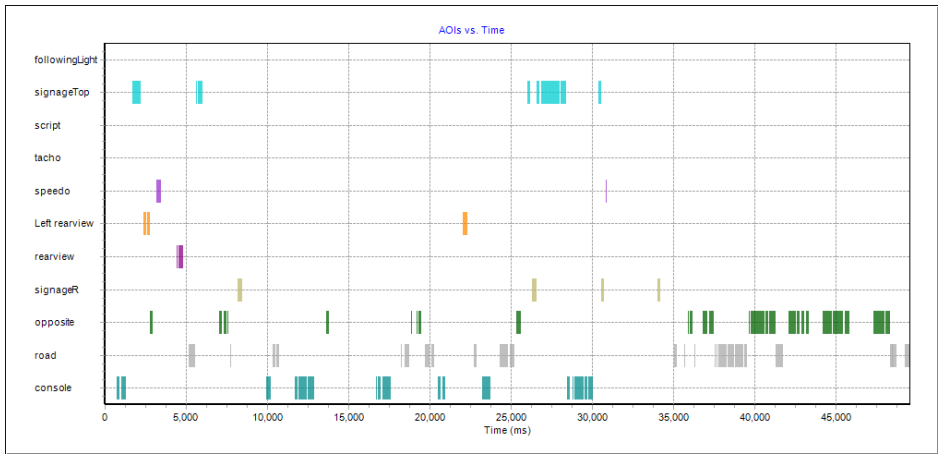
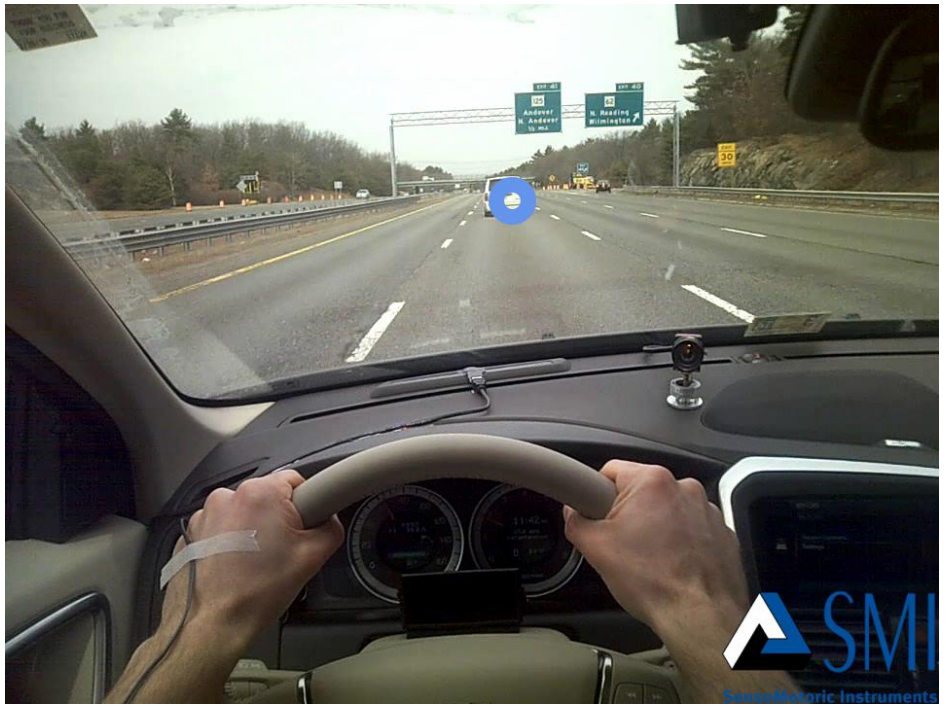
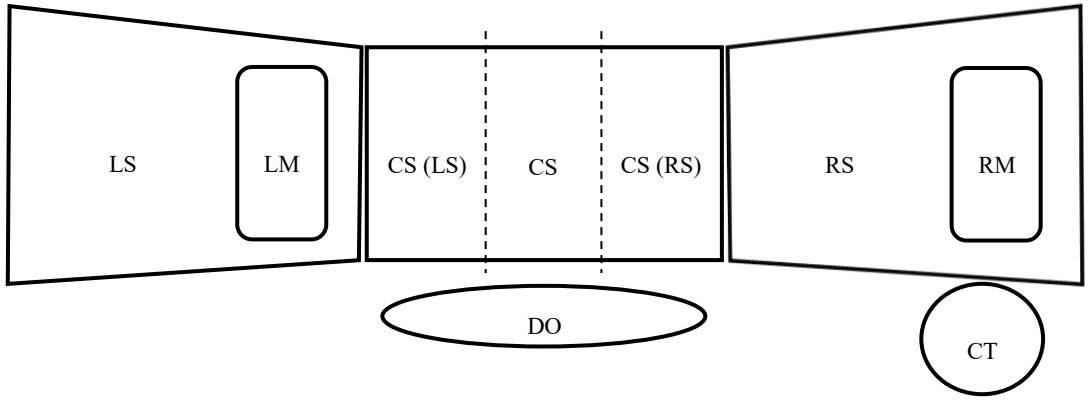


FIGURE 1 Glance Proportions (circles) and Link Probabilities (arrows) for Slow Lead Vehicle Lane Changes to the Left (N = 113 lane changes).







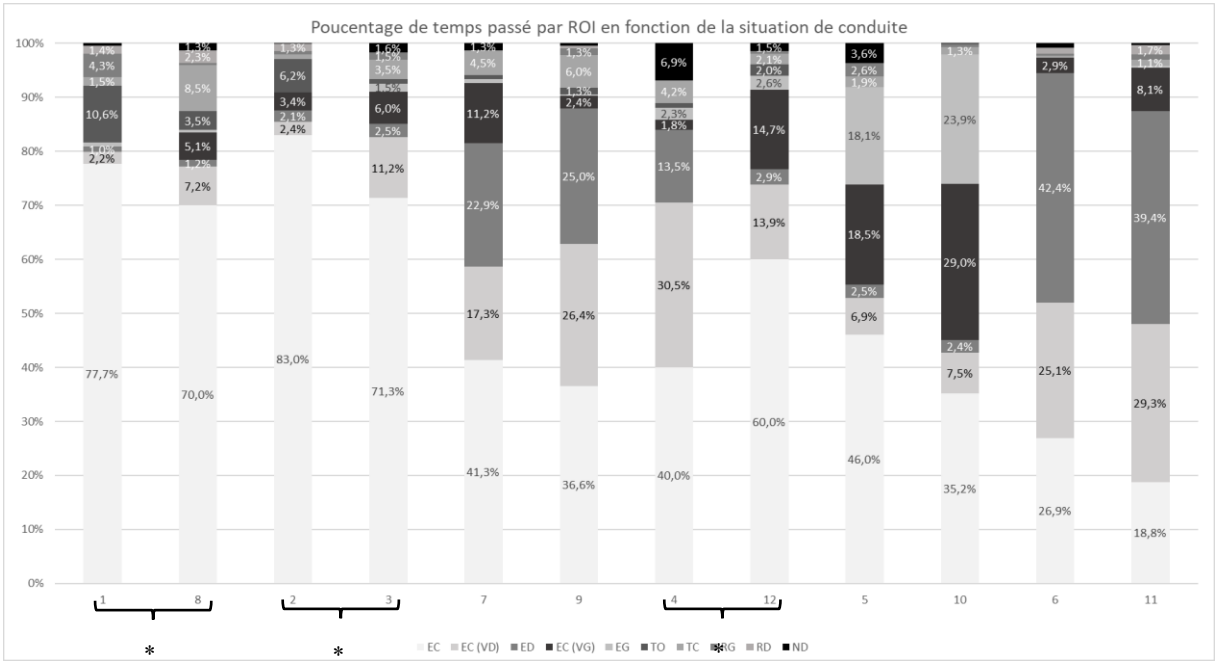
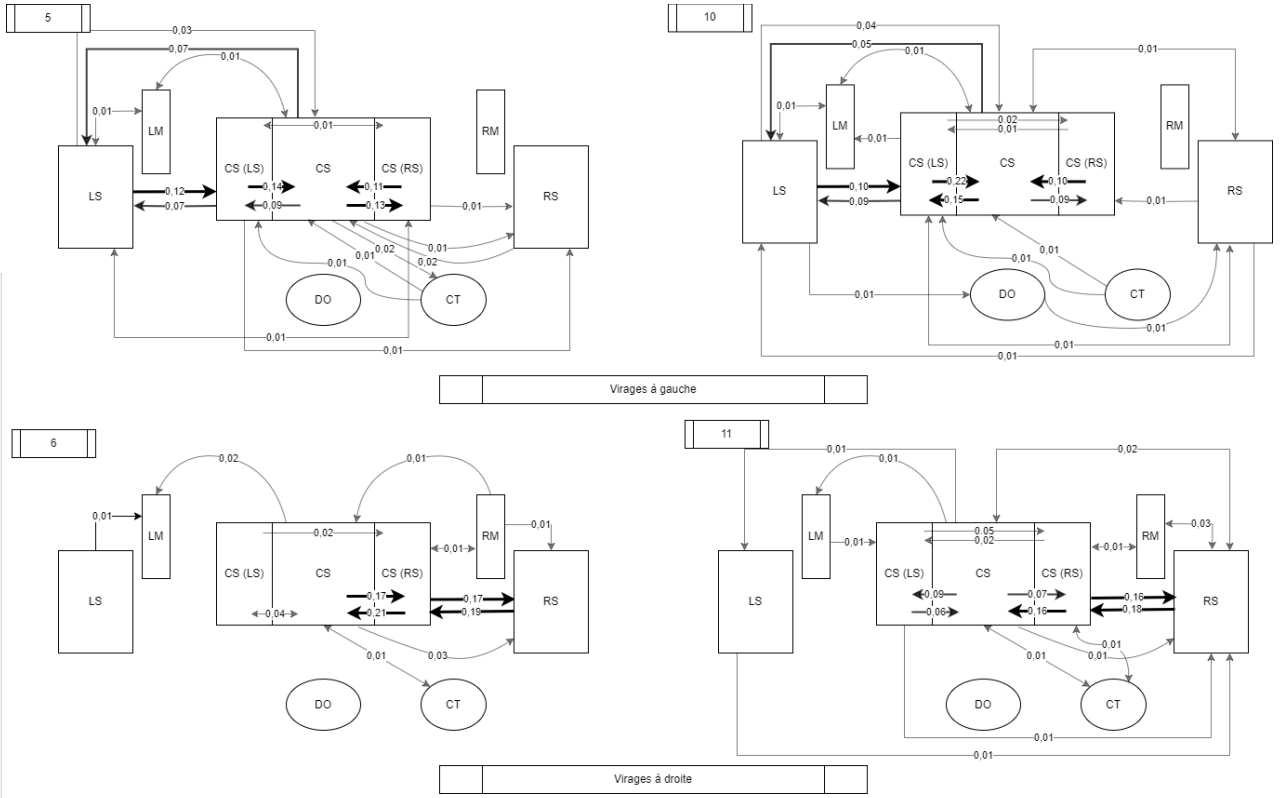
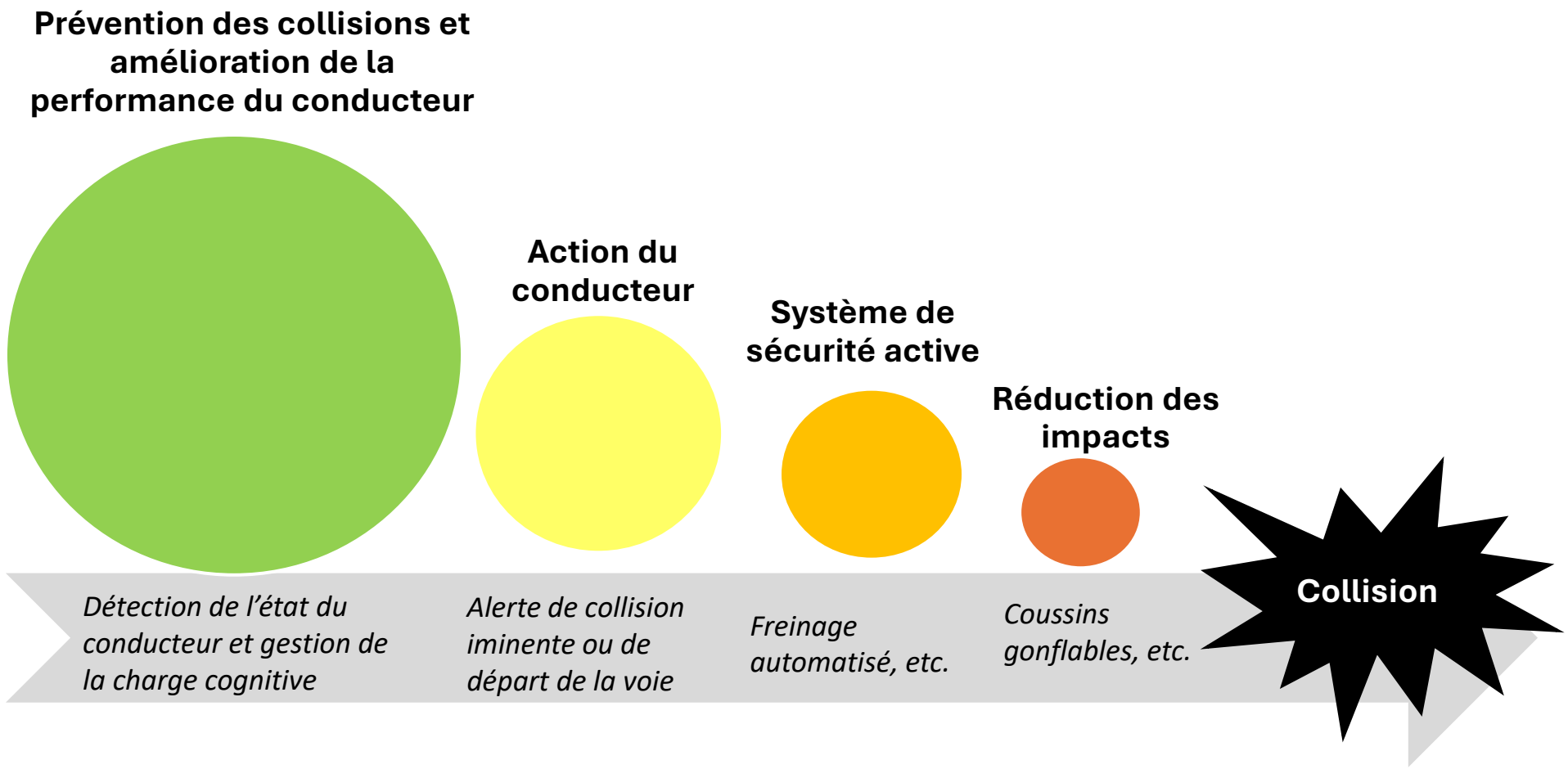


Figure 2: Percentage of time spent by ROI as a function of driving situation. Asterisks represent significant differences in a chi-square test. (*,p value < 0,05 to chi square test.). Values of percentage under 1% do not appear on the figure.



Paramedics' visual search while driving in-simulator: effects of driving contexts and type of calls

Prevention




DEATH AND SERIOUS INJURIES ARE UNACCEPTABLE
HUMANS MAKE MISTAKES
HUMANS ARE VULNERABLE
RESPONSIBILITY IS SHARED
SAFETY IS PROACTIVE
REDUNDANCY IS CRUCIAL
SAFE SYSTEM APPROACH
Safer People
Safer Vehicles
Safer Speeds
Safer Roads
Post-Crash Care

Conclusion

- A Vision Zero “strategy” — focusing on safe systems, shared responsibility, and proactive prevention—can be applied to protect those who protect us.

- A dialogue is necessary among transportation planners, agencies, first responder organizations, engineers, policymakers, and researchers to build a coordinated approach to roadside safety.

QUESTIONS

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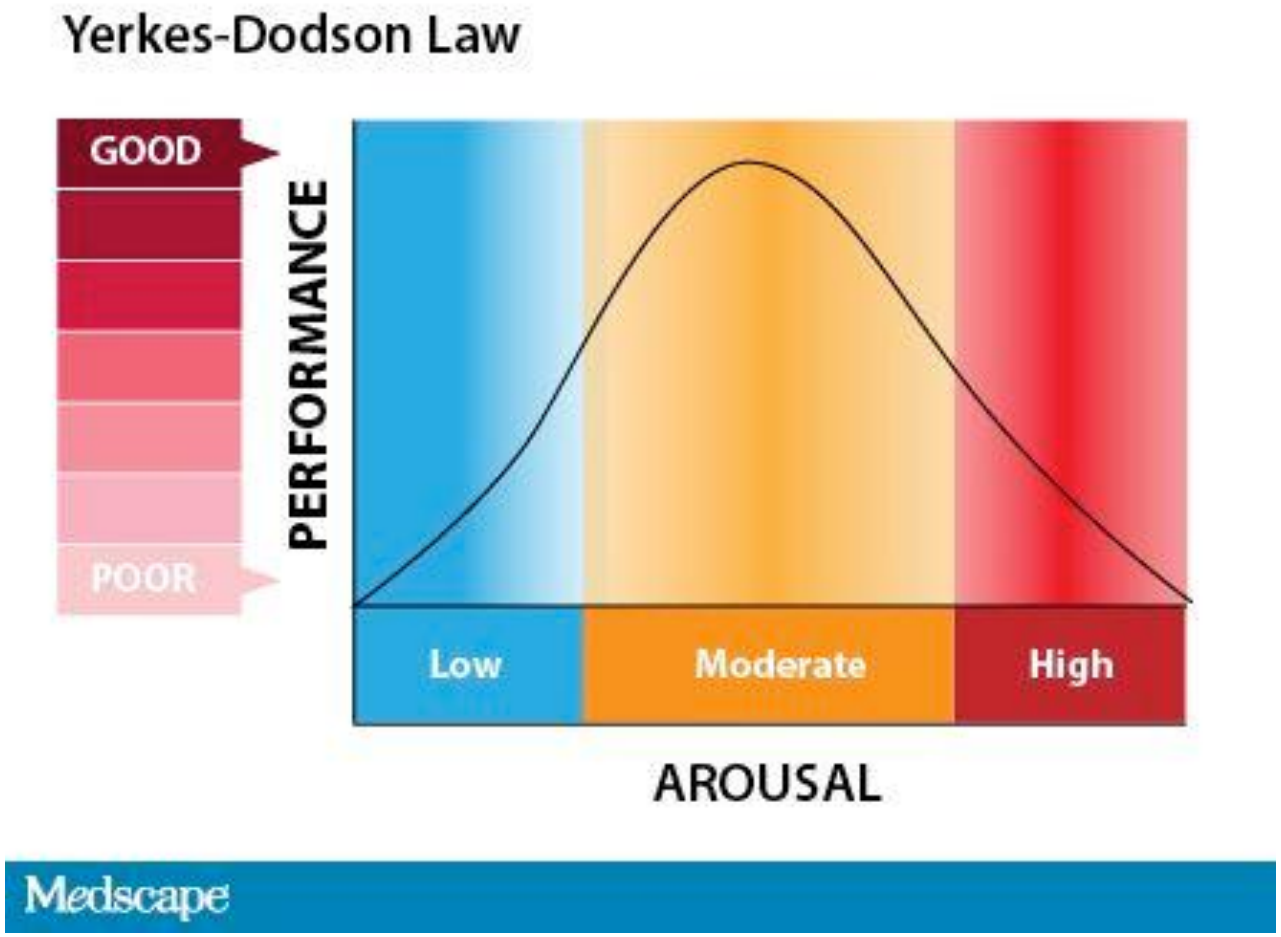
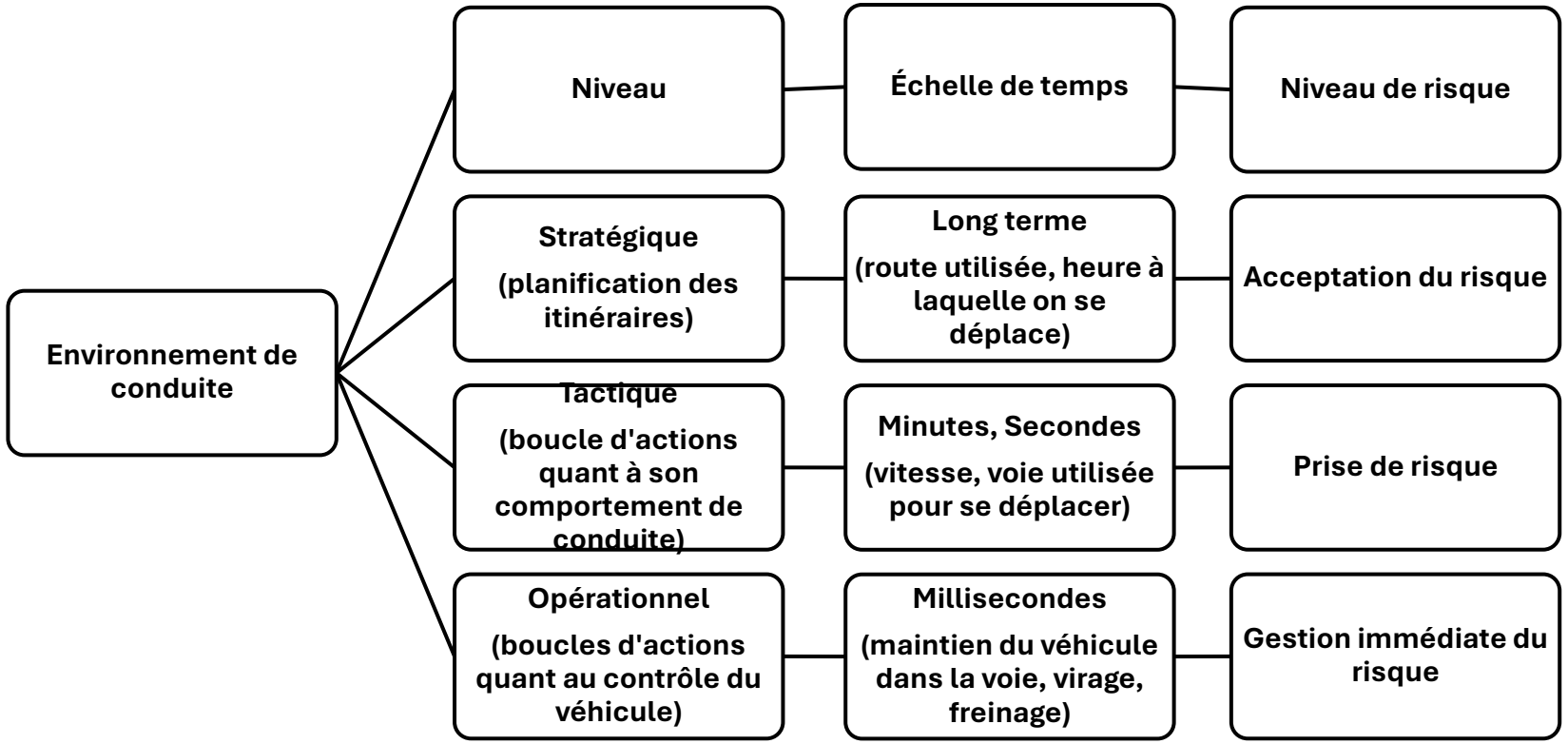
Niveau de vigilance et performance

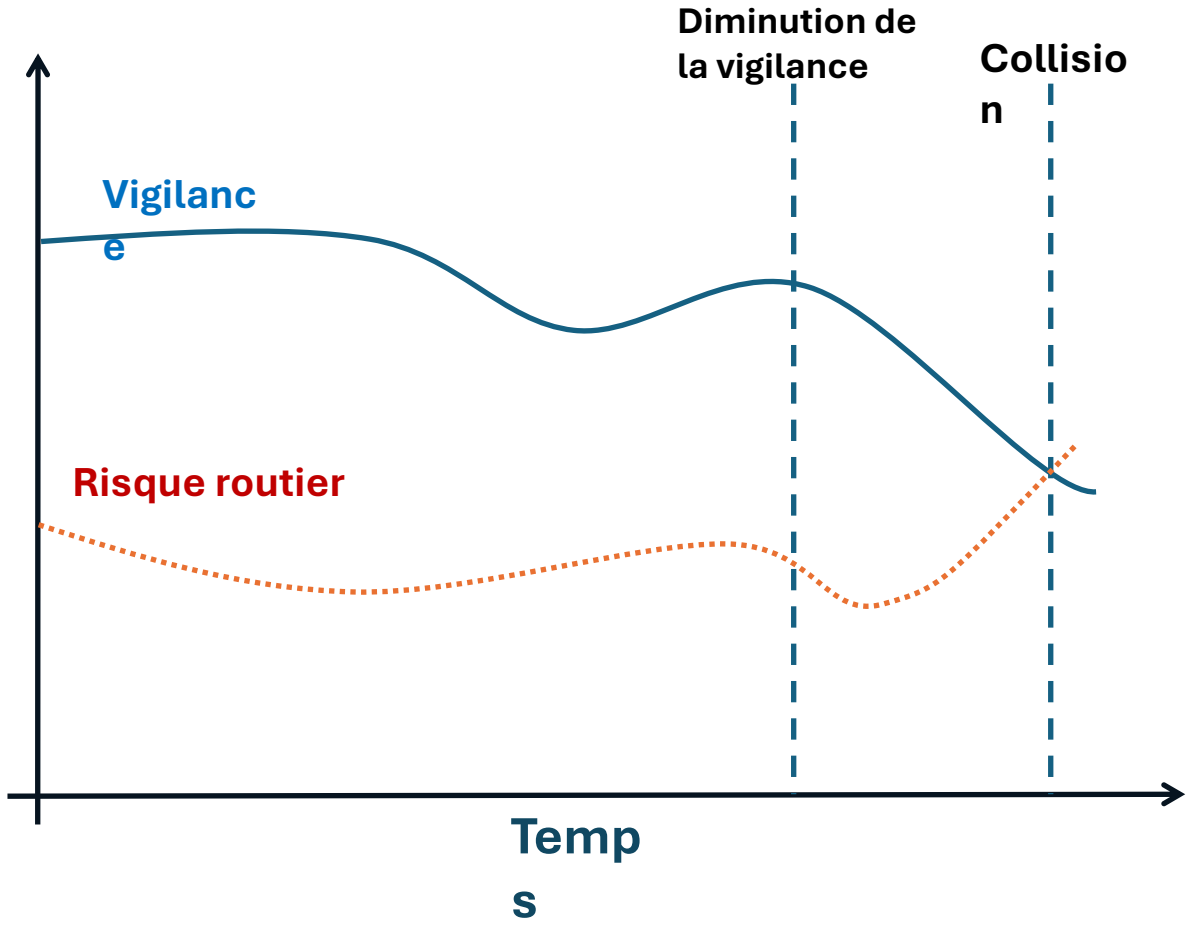


Développement des compétences à la conduite



Modèle hiérarchique de Michon

Baisse de vigilance et risque routier



✗ OLD STYLE THINKING	✓ NEW THINKING
Responsibility to prevent crashes, injuries and deaths rests with individuals	Responsibility to prevent crashes, injuries and deaths rests with system designers
Focuses on what causes 'accidents'	Focuses on what causes safety
Allows individual errors to kill and harm	It is unethical to allow individual failures to lead to death or serious injury
90 percent of the problem is people and driver error	90 percent of the solutions involve speeds, roads and vehicles
Studies the effects of single road safety interventions one at a time	Understands that road safety interventions work best together or in "bundles"
Can only justify making improvements based on a "cost-benefit" analysis	Understands the default is to make the motor vehicle and the road system safe
Only works on problems with large numbers or high crash locations	Makes the system safe everywhere
Believes in the need for further "study" — waits for crashes and coroner reports to identify problems	Recognizes that the evidence to act already exists. Proactively takes actions using data, crash testing, simulations, physics, etc.
Ignores exposure to the motor vehicle as an injury risk factor. Ignores the carbon and pollution by-products of transportation.	Embraces multi-modal transportation for better safety and environmental sustainability