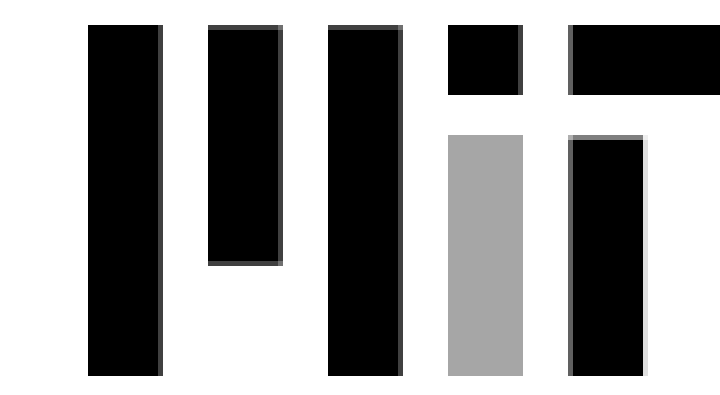


Technology-Driven Framework to Mitigate Driver Distraction

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Introduction

- The proliferation of in-vehicle systems, personal electronics, and advanced driver-assistive systems may exacerbate distraction, but at the same time, may also present an opportunity to utilize technology to mitigate distracted driving.
- Many of the building blocks for the tools needed to mitigate driver distraction already exist or are in the making. However, mitigating distraction successfully requires more than technology, infrastructure, legislation, or media campaigns - it needs an integrated framework to guide behavior change (Fig. 1).
- We propose a process model to generate insights and provide behavioral design recommendations for sustainable mitigation of driver distraction.

Objectives

A holistic, theory-grounded framework to mitigate driver distraction that can be applied as a practical tool for fostering sustained, positive changes in driver behavior.

- Create an integrative framework that goes beyond individual technological solutions, encompassing infrastructure development, legislation, education, and behavior applicable to a range of stakeholders—including engineers, designers, and policymakers.
- Leverage a process model to systematically guide interventions aimed at driver distraction mitigation, supporting long-term reductions in distracted driving through targeted monitoring, real-time attention management, and motivation-based interventions.

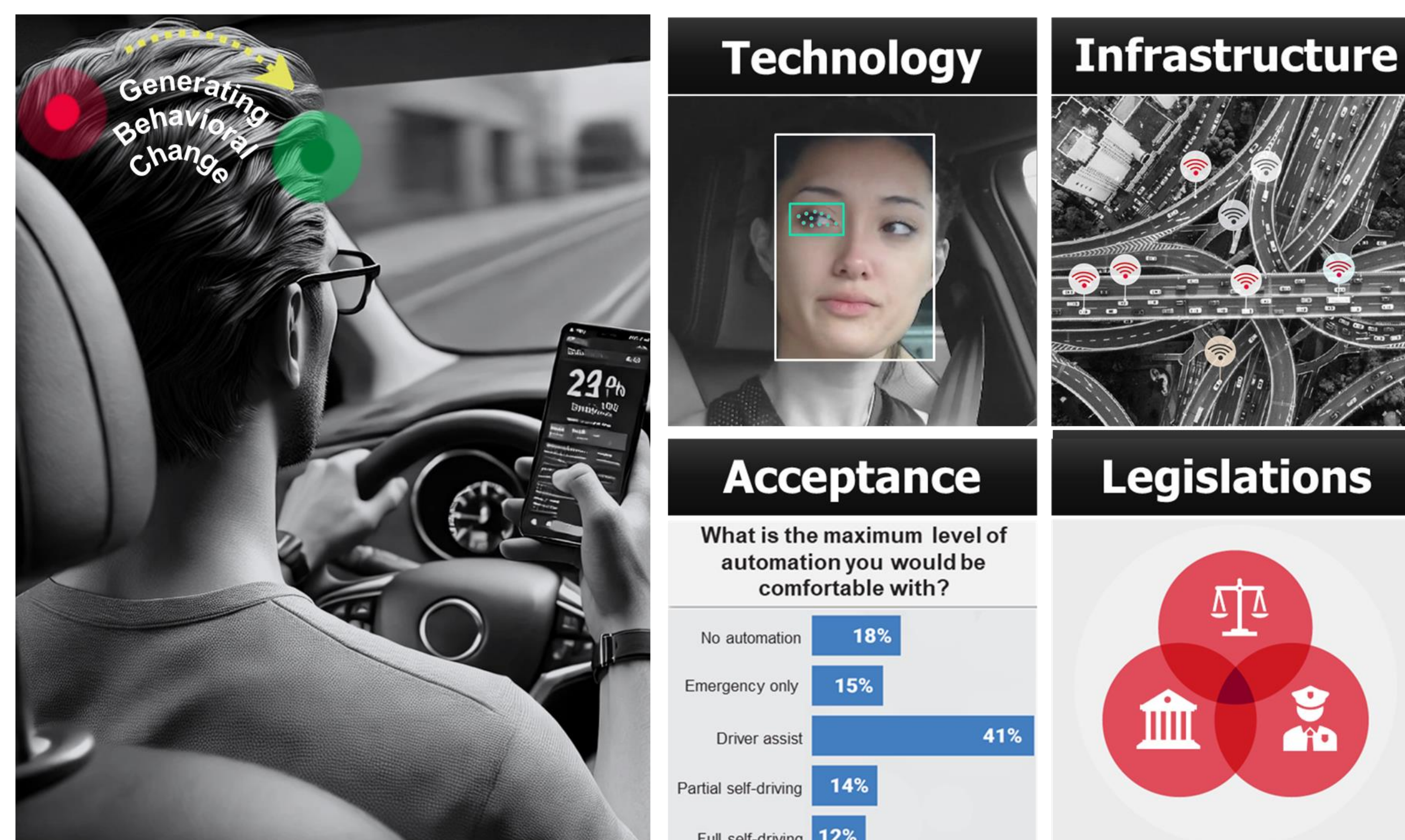


Fig.1: Enablers of behavioral changes to mitigate driver distraction

Methods

- The proposed **Monitor, Manage, and Motivate** framework (i.e., the **3M** framework) is a process model that methodically operationalizes changes in driver behavior.
- Consisting of three components: (i) **Monitor** provides the functionality related to sensing the driver state within the dynamic driving environment; (ii) **Manage** oversees decision-making and behavior changes by implementing interventions like multimodal alerts and restricting functionalities; and (iii) **Motivate** targets sustainable behavioral shifts by employing incentives, coercion, and gamification to foster positive changes.

The 3M Framework

Each of the components in the 3M framework is responsible for handling different aspects of the distracted driving problem. When combined, these components result in a framework that promotes and supports safe driving by managing attention on a moment-to-moment basis and inducing long-lasting changes to driver motivations (Fig. 2).

Monitor

- Sense driver state within the dynamic driving environment (guided by expected behaviors) and communicate it to the Management component. Driver monitoring systems (DMS) offer new opportunities to monitor the driver's state in real time, utilizing a wide range of sensors.
- Monitor the physiological state of the driver (e.g., impairment due to fatigue, alcohol, or THC) and interactions with in-vehicle systems (e.g., tapping frequency).
- Capture driving performance (e.g., speeding and lane position) to infer the driver's state within the driving environment.
- Recent technologies enable external monitoring of the driver state (e.g., cameras for traffic violations) also capturing driver activities within the vehicle.

Manage

- A decision-making component that executes tactical changes in driver behavior, relying on robust monitoring, formalized rules, and the availability of multimodal interventions.
- Uses control theory to align observed driver behavior with desired behavior (e.g., visual attention, risk-taking propensity).

- Deviation from the desired behavior triggers alerts, restriction-based interventions that incite a behavior change, or limit the opportunity to engage in distracting activities.

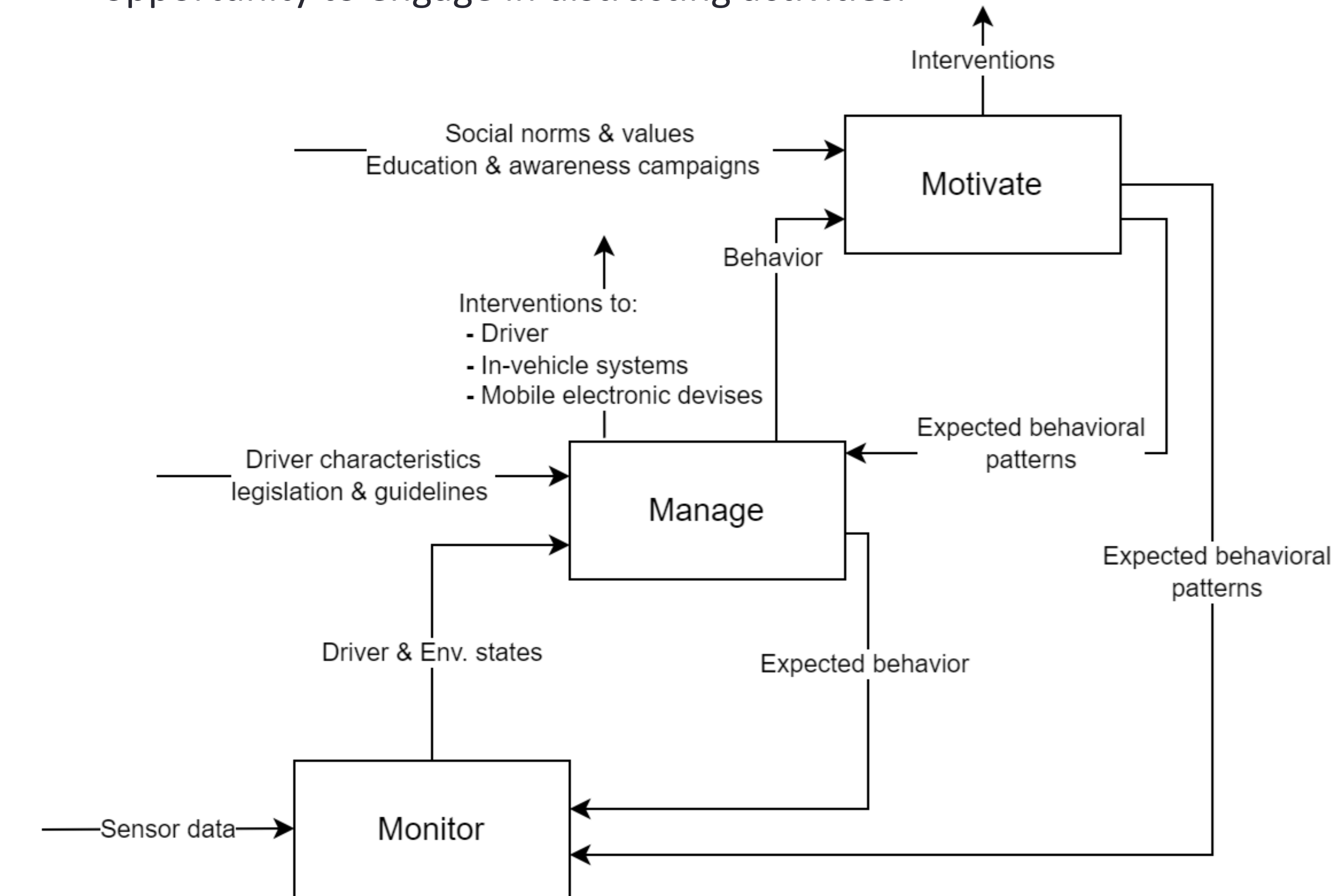


Fig.2: The 3M framework core functional components and the information flows between them.

Motivate

- Aims for sustainable behavior change by targeting driver motivations, habits, and decision-making processes.
- Uses incentives, gamification, education, and awareness campaigns to encourage positive behavior. Interventions focus on reinforcing desired behaviors and deterring risky actions through rewards, penalties, and social influence.
- Promotes changes beyond immediate actions, fostering long-term safe driving habits.

Conclusions

The technology-driven framework—**Monitor, Manage, Motivate (3M)**—addresses the risks of distracted driving by guiding driver behavior and mitigating distractions. The 3M framework aims to leverage enhanced sensing, personalized interventions, and automation integration to promote safe driving habits, maintain driver attention, and foster long-term behavioral change.

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