Psychology of Autonomous Automobiles

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Biggest Challenge

- Failure to understand driver psychology
  - Obsession with perception relative to situation awareness
  - Cars are increasingly media objects
  - Ignoring the importance of mental models

- Failure to understand sociology of technology
  - The “rabid dog” mistake
Generations of Vehicles from a Psychological Perspective
Best Definition of Situation Awareness

Knowing what is going on in order to know what to do
Dimensions of Situation Awareness

- **Dimension 1: Perception**
  - Consuming *relevant* information

- **Dimension 2: Comprehension**
  - What does (1) *mean* to *me*?

- **Dimension 3: Planning**
  - What should I *do* given (2)?

- The three levels of SA are *inter*dependent
Generation 1 and Situation Awareness

- No automation
- SA concerns for 1st generation automakers are *perception*
  - Maximize visibility
    - Visibility of road
  - “Drivers want to pay attention: car shouldn’t pull them away”
  - Visibility of functions
  - Eyes-free control
- These concerns persist in all generations (except Complete Automation)
Generation 2 and Situation Awareness

- *Hidden* automation
  - Electronic Stabilization Program (ESP)
  - Anti-lock brakes
  - *Drivers don’t need to know about this intelligence, especially not in real time*

- New concern was *risk homeostasis* (if car drives better, I can be less cautious)
  - Perception: Driver pays less attention
  - Comprehension: Driver doesn’t think very hard
  - Prediction: Drivers react more slowly and casually

- Little evidence of risk homeostasis
Generation 3: Two Approaches

- Third Generation A: *Full automation part* of the time
  - Autonomous driving at certain points, Manual at others
- Third Generation B: Partial automation *all* of the time
Biggest Problem in Generation 3

- Supporting mental models of the driver
- Car must be:
  - Teacher
  - Teammate
Generation 3A: Full automation part of the time

- What are drivers doing during automation?
  - Attend to the road?
    - Terrible idea that seems like a good idea
      - Boredom and drowsiness
      - People don’t pay for safety
      - Not really situation aware
  - Doing a secondary task
    - Transition from Automation to Manual is critical moment
Transition from Automation to Manual is Critical Moment

- **Perception**
  - Looking back where you were looking is very tempting

- **Comprehension**
  - “It’s pouring rain?”
  - Valence transference
  - Drowsiness/sleep

- **Planning**
  - Risk homeostasis
  - Arousal transference
Generation 3B: Partial Automation All of the Time

- Perception
  - Habituation of not looking in certain places
- Comprehension
  - Is it worth thinking about?
- Planning
  - What should I be doing and what should the car be doing?
Generation 4

- Completely automated car
- No situation awareness problems
We have to radically change our paradigms!
Change in Paradigm 1

*From:* Attention is Job 1 for the driver

*To:* Situation Awareness is Job 1 for the *car*
  - Especially for comprehension and planning

**Examples:**

- Car should:
  - *Identify* what to worry about
  - *Explain* how to worry about it
  - *Drag* driver into the present
Change in Paradigm 1A

*From:* Drivers want to pay attention; interfaces should not distract

*To:* Drivers do *not* want to pay attention; we have to encourage their attention

Examples:

1. When eyes linger on center panel, show view from windshield
2. Show dangerous obstacles on side window
3. Put critical content where driver attention is
Change in Paradigm 2

*From:* Manipulation of interface is discrete and time-limited

*To:* Manipulation of interface is continuous

Examples:

1. Need new definitions of distraction (eyes on road is not enough)
2. Must measure attention continuously
Change in Paradigm 3

*From:* Mental models are hardware-oriented

*To:* Mental models are software-oriented

- Automated/autonomous vehicles

**Examples:**

1. Car must create and support mental models of how car behaves
Change in Paradigm 4

From: Cars are *mechanical* devices that are *consequential* and *demand attention* which must be *controlled* by a driver

To: Cars are a collection of a dozen *screens* which are *casually consumed* by drivers

Examples:
1. Automotive psychology is screen psychology
Change in Paradigm 5

From: Fully automated cars are wild dogs

To: Fully automated cars are domesticated dogs

Examples:
- “No one will trust an automated car” to
- “What a wonderful companion”
- Has any technology been stopped by one accident?