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)

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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 reacts 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

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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!

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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?