Human Factors of Advanced Driver Assistance Systems (ADAS)

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What Might the Future of Driving Look Like?
We Might Not Be Far Off
Automation in the News

A Google self-driving car caused a crash for the first time

*A bad assumption led to a minor fender-bender*


Google's self-driving car at fault in accident

http://money.cnn.com/2016/02/29/autos/google-self-driving-car-accident/

Google self-driving car crashes into a bus (update: statement)

*It may be the first instance of a Google autonomous car being at fault in an accident.*

http://www.engadget.com/2016/02/29/google-self-driving-car-accident/

GOOGLE’S SELF-DRIVING CAR CAUSED ITS FIRST CRASH

http://www.wired.com/2016/02/googles-self-driving-car-may-caused-first-crash/
Evolution of Technology

Present: Driver Assistance Systems

State-of-the-Art & Future
Vehicle Assistive Technologies

- Lane Keeping
- Adaptive Cruise Control
- Forward Collision Mitigation
- Park Assist
- Adaptive Headlights
Market Penetration of Technology – Frontal Airbags

% of new vehicles

Predicted values

http://www.iihs.org/iihs/sr/statusreport/article/47/1/1
Market Penetration of Technology – FCWM

% of new vehicles

Predicted values

95% by 2049

http://www.iihs.org/iihs/sr/statusreport/article/47/1/1
Driving Simulation & ADAS

- May facilitate driver response
- Lowers awareness of the environment
- Increases engagement in secondary tasks
- May increase risky driving in novice users

Parasuraman et al. (2000), Merat et al. (2012), Carsten et al. (2012), Muhrer et al. (2012)
Potential Benefits of ADAS

- Able to respond when human cannot or does not
- Helps gather information
- Compensates for distracted drivers

Muhrer et al. (2012), Mulder et al. (2012), Bao et al. (2012)
ADAS Programmatic Research

- ADAS testing an outgrowth of vehicle performance and safety testing

- **Year 1 Efforts (2014-2015):**
  - ADAS interaction with inflatable targets
  - ADAS interaction with pedestrian targets
  - Vehicle dynamics and human factors perspective

- **Year 2 Efforts (2015-2016):**
  - Driver learning through repeated exposure to ADAS
  - Understanding how drivers react to, use, and understand multiple ADAS systems
  - Analyses are on-going…
Forward Collision Warning & Mitigation System
Testing Human-ADAS Interaction

- Eye tracking and in-vehicle video recording
- Vehicle data acquisition, hi-precision GPS
- Dynamic naturalistic driving events
- Closed course testing
- 35 MPH, 40 feet of headway
- Balloon car deployment on straightaway
- 2 traffic lights
In-vehicle Eye Tracking
What Did We Find?

- 14 of 16 participants reacted to avoid hitting the balloon car
- Auto-braking (FCM) engaged for 2 participants
- Attentive drivers can avoid collision, even with active ADAS
- FCWM cannot prevent accidents, but can mitigate
- When distracted by cellular phone use, FCWM activations increase

No substitute for attentive driving
What Did We Find?

- FCWM was **not associated** with:
  - riskier driving behaviors
  - disruption to driver’s ability to control vehicle

- Collision warning may facilitate response under conditions of divided attention
Year 2 Results - Preview

Systems tested:
• Adaptive Cruise Control
• Lane Departure Warning

Results show technologies:
• Enhance safety
• Require attentive driving

The changing role of the driver:
• Passive monitoring?
• Timely intervention?

Crump et al. (2015), Baraket et al. (2015)
Thank you!

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