Automated Driving
Are we taking the Human Factors Researcher out of the Loop?

Sanna Pampel
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Sanna Pampel

- Background in information systems and software development
- PhD about drivers’ mental models in Leeds
- Today research Fellow for Automotive Human Factors

- Automotive research in Nottingham
  - Mirrorless cars
  - Emotions and experiences
  - HMI in partially automated driving
Human Factors Research Group

• ~25 staff, ~30 PhD students

• Researching human beings and:
  – Novel technologies
  – Complex systems
  – Safety
  – Implications on trust and user behaviour

• Automotive HMI work – 5 staff, 8 PhD students
  – Funded by vehicle manufacturers, EU, UK government
Core Human Factors issues

- Attention
- Situation awareness
- Mental models
- Behavioural adaptation
- Risk
- Trust
- Anthropometry/Biomechanics
- Workload and stress
- Human error

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Automated Driving
Are we taking the Human Factors Researcher out of the Loop?
British drivers spend 124 hours in traffic jams each year\(^1\)

\(^1\) http://www.inrix.com
Definitions

Automated
• “automatically controlled operation of an apparatus, process or system by mechanical or electronic devices that take the place of human labour” ¹

Takeover and handover
Takeover is initiated by driver and handover by the vehicle

Autonomous
• “not subject to control from outside; independent” ¹
• driverless

¹ http://dictionary.reference.com
Vehicle automation levels

Vehicle control

- Level 0: No automation
- Level 1: Assisted
- Level 2: Partial automation
- Level 3: Conditional automation
- Level 4: High automation
- Level 5: Full automation

Operator control

SAE document J3016, see http://standards.sae.org/j3016_201401
Vehicle automation levels

Vehicle control

Level 0  No automation

Level 1  Assisted

Level 2  Partial automation

Level 3  Conditional automation

Level 4  High automation

Level 5  Full automation

Operator control

SAE document J3016, see http://standards.sae.org/j3016_201401
Level 0 No automation

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Vehicle automation levels

Vehicle control

- **Level 0** No automation
- **Level 1** Assisted
- **Level 2** Partial automation
- **Level 3** Conditional automation
- **Level 4** High automation
- **Level 5** Full automation

Operator control

SAE document J3016, see http://standards.sae.org/j3016_201401

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Level 1 Assisted

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Vehicle automation levels

Vehicle control

Level 0  No automation
Level 1  Assisted
Level 2  Partial automation
Level 3  Conditional automation
Level 4  High automation
Level 5  Full automation

Operator control

SAE document J3016, see http://standards.sae.org/j3016_201401

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Level 2 Partial automation

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Vehicle automation levels

Vehicle control

- Level 0  No automation
- Level 1  Assisted
- Level 2  Partial automation
- Level 3  Conditional automation
- Level 4  High automation
- Level 5  Full automation

Operator control

SAE document J3016, see http://standards.sae.org/j3016_201401

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Level 3 Conditional automation

By Tesla Motors Inc. - Tesla Motors Inc.
Vehicle automation levels

Vehicle control

Level 0  No automation

Level 1  Assisted

Level 2  Partial automation

Level 3  Conditional automation

Level 4  High automation

Level 5  Full automation

Operator control

SAE document J3016, see http://standards.sae.org/j3016_201401

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Level 4 High automation

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Vehicle automation levels

Vehicle control

- **Level 0**: No automation
- **Level 1**: Assisted
- **Level 2**: Partial automation
- **Level 3**: Conditional automation
- **Level 4**: High automation
- **Level 5**: Full automation

Operator control

SAE document J3016, see http://standards.sae.org/j3016_201401

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Level 5 Full automation

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Vehicle automation state-of-the-art

- Audi, Mercedes, BMW level 3
- Ford ‘affordable’ Level 3
- Tesla level 3

- Google car level 3/4 with hundreds of handovers recorded
- Level 5 not for another 10 years\(^1\)

Department for Transport: 'The pathway to driverless cars: summary report and action plan' (DfT, 2015)
Level 3 requires a responsible ‘driver’

• Driver engagement
  – Fatigue and mindwandering
  – Long takeover times
  – Degradation of skills
  – Trust and complacency
  – Misuse

First fatalities in level 3 automation
Level 3 requires a responsible ‘driver’

- Re-engaging the driver
  - Keeping the driver in the loop

- Encouraging manual operations
- Measuring driver state
Jump to full automation

Level 0  No automation

Level 1  Assisted

Level 2  Partial automation

Level 3  Conditional automation

Level 4  High automation

Level 5  Full automation

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Jump to full automation

• Overcoming the intermediate levels
• Tesla
  – Fully autonomous by 2018?
• Ford
  – Fully autonomous by 2021?

Does this mean we do not need to take the human into account?
Fully autonomous vehicles – no humans?

• Human in vehicles
• Humans outside of vehicles
• Traffic environment
• Society
Humans in vehicles

- Trust and adoption
- Emotions, comfort and experiences
- Communication with car
- Non-driving activities
- Driving pleasure
  - Will people not be allowed to actively drive?
Humans outside of vehicles

• Safety
• Trust and acceptance
• Predictability and communication with ‘driver’
• Transition and mixed traffic
  – Regional and cultural differences
  – Feedback into R&D
Traffic environment

• Ethical decisions
• Impact on traffic safety, travel quality, travel time, lifestyles
  – Mobility improvement and inclusivity
• Connected vehicles
• Misuse of ‘safe’ cars in traffic
Society

• Laws, regulations
• Unemployed taxi/bus/lorry drivers
• Ownership and business models
  – Mobility as a service
• Security and insurance
Artificial Intelligence

• Maintenance with less hassle
• Knowing driver state to enhance experience
• Adapting to driver’s goals
  – Personalisation
Artificial Intelligence

• Learn human bad habits
  – Google car accident

• Learning mechanisms can adapt over time
  – Rules need to be put in place
  – Will humans understand the car’s behaviour changes?

Photograph taken by Polimerek in MIT Mus.
Artificial Intelligence

• Shall autonomous cars drive like humans or machines?
  – A better version of ourselves?
  – Disappointed inevitable
Can we address the challenges?

• Fully autonomous cars not existing yet
  – Only in limited areas
• Many questions

How can we find answers now?

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Human factors exploring solutions

- Explore problem
- Find research question

- Answer might not involve full scenario
- More opportunities as cars become increasingly automated
Take aways

• Automation promises safety and increased road capacity
• Partially automated vehicles are an exciting human factors research field
• However, engaging/re-engaging the driver is difficult, and potentially dangerous
• Hence, announcements of fully autonomous vehicles
Take aways

• Human factors challenges remain
  – Human in vehicles
  – Humans outside of vehicles
  – Traffic environment
  – Society

• Interesting challenges posed by AI

• Research efforts to tackle questions before autonomous vehicles are widely in use
So, are we taking the Human Factors Researcher out of the Loop?

No. Humans will still need to be considered.
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Thank you!

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