Anticipating the individual User
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AUTOMATION VS. AUTONOMY

• [...] automaton as technology that requires human intervention or control and autonomy as technology capable of working alongside humans as teammates, carrying out the essential taskwork and teamwork functions of a human teammate (McNeese et al., 2016).

• Autonomy capitalizes on technology’s ability to make intelligent decisions and adapt to task, situation, and context, [...] (Cox, 2013).

The largest proportion of pilot errors is due to incorrect perception (70.3%) and understanding of the situation (20.3%) (Jones & Endsley, 1996).
ANTICIPATING THE INDIVIDUAL USER

• Trace User behavior, in the task context, in the specific situation and in the context.

• Is the user in the cognitive state predicted by the model?
  • What information has been perceived and processed?
  • Is the state of Situation awareness accordingly?
  • Do we anticipate a surprise reaction of the operator?
  • Can the model explain the behavior witnessed?

• When the cause of diverging behavior is known, assistance can better and quicker address the operator and the problem.
Cognitive Models for intelligent interfaces in the Cockpit

Further cooperation partners:

Thorsten Zander
Laurenz Kroll
Christoph Vernaleken
Inge Wenzel


The cognitive model should keep track of the learning process and the various cognitive states in real time, and inform the training system to deliver training material in ways that facilitate the effectiveness of training.

NEUROADAPTIVE MODEL
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Simulator

Cognitive model

Pilot

Aircraft parameters

Task analysis

EEG data
Hear alert
Predict response
Check pilot response

Response found → Evaluate hit
No response found → Check EEG-data

P300 → Predict response
No P300 → Predict no response

Evaluate false alarm
Evaluate correct rejection

FLIGHT INFO in imaginal buffer

<table>
<thead>
<tr>
<th>Slots</th>
<th>Values</th>
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<tbody>
<tr>
<td>Airspeed</td>
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<tr>
<td>Altitude</td>
<td>y feet</td>
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<tr>
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<td>incr./decr.</td>
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<tr>
<td>altitude-trend</td>
<td>incr./decr.</td>
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<tr>
<td>p300</td>
<td>0/1</td>
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<tr>
<td>var-name</td>
<td>response (where)</td>
</tr>
<tr>
<td>var-value</td>
<td>response (what)</td>
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</table>
\[ Mdn_{\text{Norm.}} = 0.73 \ (IQR = 0.8 - 0.67) \]
\[ Mdn_{\text{Neuro.}} = 0.92 \ (IQR = 1.0 - 0.9) \]
A COGNITIVE MODEL FOR THE TAKEOVER IN HIGHLY AUTOMATED DRIVING

• Marlene Scharfe
• TU Berlin & Robert Bosch GmbH
AIMS

1. Anticipating cognitive processes during take over procedure
2. Detect individual differences e.g. by subjectively perceived complexity
3. Interaction with a dynamic environment (context)
4. AOIs for visual perception based on the SEEV-theory (situation),
5. Predict behavior e.g. duration of take-over or quality of decision (task)

SEEV model of visual attention: Sebastian Wiese

Salience + Expectancy - Effort + Value

guiding visual attention

Salience + Relevance - Effort – Inhibition of Return

For better collaboration between technical systems and the user an understanding of Task, Situation and Context is needed.

The model or cognitive system does not need to capture all details but the most relevant aspects.

- The individual trace of events and attention allocation (e.g. information or transitions missed)
- Individual differences of information processing (e.g. spatial cognition, working memory capacity, subjective complexity…)

High relevance to understand why the operator's behavior differs from expected behavior.

For such approaches we need to combine model approaches with physiological methods and share information from the processing systems.
THANK YOU!

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