

## Working towards a Meaningful Transition of Human Control over Automated Driving Systems

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**Publication date**

2018

**Document Version**

Final published version

**Citation (APA)**

Heikoop, D., & Hagenzieker, M. (2018). *Working towards a Meaningful Transition of Human Control over Automated Driving Systems*. Poster session presented at DDI 2018: 6th International Conference on Driver Distraction and Inattention, Gothenburg, Sweden.

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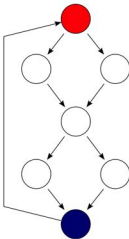



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# Working Towards a Meaningful Transition of Human Control over Automated Driving Systems

MHC-ADS

	<h2>The Questions</h2>	<p>What do we know about human behaviour in automated driving?</p> <p>What Human Factors play a role during automated driving?</p> <p>What role do they play during a transition of control?</p> <p>Which skills, rules, and knowledge are involved?</p> <p>Can we go from a technical perspective to a human-oriented perspective?</p>																																			
	<h2>The Aim</h2>	<p>Develop a framework of human control over automated driving sytems.</p> <p>Take a quantitative approach.</p> <p>Use literature on skills, rules, and knowledge with automated driving.</p> <p>Take a novice driver just granted their license as a baseline.</p> <p>Maintain a EU-wide perspective.</p>																																			
	<h2>The Process</h2>	<p>Step 1: SAE Levels of Automation - the starting point.</p> <ul style="list-style-type: none"><li>- No Automation (level 0) to Full Automation (level 5).</li></ul> <p>Step 2: Classification of human behaviour (Rasmussen, 1983).</p> <ul style="list-style-type: none"><li>- Skill-, rule-, &amp; knowledge-based behaviour.</li></ul> <p>Step 3: Human behaviour at level 0 - the baseline.</p> <ul style="list-style-type: none"><li>- Skills, rules &amp; knowledge during manual driving set by EU.</li></ul> <p>Step 4: The Levels of Automation (level 1-3).</p> <ul style="list-style-type: none"><li>- Little literature; use of known ADAS &amp; advanced training courses.</li></ul> <p>Step 5: The unknown - beyond human fall-back (level 4-5).</p> <ul style="list-style-type: none"><li>- Non-existent, open for debate and imagination.</li></ul>																																			
	<h2>The Results</h2>	<table><tr><th>Automation</th><th>SAE 0</th><th>SAE 1</th><th>SAE 2</th><th>SAE 3</th><th>SAE 4</th><th>SAE 5</th></tr><tr><th>Human</th><td>No Automation</td><td>Driver Assistance</td><td>Partial Automation</td><td>Conditional Automation</td><td>High Automation</td><td>Full Automation</td></tr><tr><td>Skill</td><td>128<sup>1</sup></td><td>127 - 114</td><td>114</td><td>114 - 43</td><td>40 - 0?</td><td>39 - 0?</td></tr><tr><td>Rule</td><td>254<sup>2</sup></td><td>255 - 250</td><td>250</td><td>250 - 69* - 66</td><td>51 - 29?</td><td>29 - 0?</td></tr><tr><td>Knowledge</td><td>65<sup>3</sup></td><td>65 - 81</td><td>81</td><td>81 - 34?!</td><td>0 - ?!</td><td>0?</td></tr></table> <p><small>1 = Harmonisation of the Assessment of Driving Test Candidates (CIECA RSC working group, 2006) 2 = Convention on road traffic (United Nations, 1968; 2014) 3 = Various advanced driver training courses (a.o.) * = In case of accident; i.e., when automation is not capable of avoiding an accident ? = Unknown situations at higher levels of automation ! = Driver skill-/rule-based behaviour may deteriorate to knowledge-based ! = Fall-back to human up to level 3 -&gt; human needs at times adhere to level 0</small></p>	Automation	SAE 0	SAE 1	SAE 2	SAE 3	SAE 4	SAE 5	Human	No Automation	Driver Assistance	Partial Automation	Conditional Automation	High Automation	Full Automation	Skill	128 <sup>1</sup>	127 - 114	114	114 - 43	40 - 0?	39 - 0?	Rule	254 <sup>2</sup>	255 - 250	250	250 - 69* - 66	51 - 29?	29 - 0?	Knowledge	65 <sup>3</sup>	65 - 81	81	81 - 34?!	0 - ?!	0?
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	<h2>The Implications</h2>	<p>The decline in skill- and rule-based behaviour</p> <p>The rise and fall of knowledge-based behaviour</p> <p>The human driver as a fall-back mechanism</p> <p>SAE level 4 and 5 automation: the path of the unknown</p>																																			
	<h2>The “Now What?”</h2>	<p>Mismatch between supply and demand!</p> <p>Human-oriented taxonomy.</p> <p>Empirical testing.</p> <p>Qualitative approach?</p>																																			