

The search for personal control over our automated cars: tailor-made or tailor-taught?

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Meaningful human control over
Automated Driving Systems

Human behaviour & psychology

What can and can't we do?



Automated cars and human behaviour: a happy marriage?

Automated car looks promising

No more driving!



Automated cars and human behaviour: a happy marriage?

Automated car looks promising

No more driving!

Well...



Automated cars and human behaviour: a happy marriage?

Pay attention to the road

Watch out for errors of the car

Mind its limits

Understand what it's doing

Take over whenever necessary



Automation		SAE 0	SAE 1	SAE 2	SAE 3	SAE 4	SAE 5
		No automation	Driver assistance	Partial automation	Conditional automation	High automation	Full automation
Human	Skill						
	Rule						
	Knowledge						

Automation		SAE 0	SAE 1	SAE 2	SAE 3	SAE 4	SAE 5
		Human	No automation	Driver assistance	Partial automation	Conditional automation	High automation
Skill		128					
Rule		254					
Knowledge		65					

Automation		SAE 0	SAE 1	SAE 2	SAE 3	SAE 4	SAE 5
		No automation	Driver assistance	Partial automation	Conditional automation	High automation	Full automation
Human	Skill	128	127-114	114			
	Rule	254	255-250	250			
	Knowledge	65					

Automation		SAE 0	SAE 1	SAE 2	SAE 3	SAE 4	SAE 5
		No automation	Driver assistance	Partial automation	Conditional automation	High automation	Full automation
Human	Skill	128	127-114	114			
	Rule	254	255-250	250			
	Knowledge	65					

A: Goes down
 B: Remains the same
 C: Goes up
 D: Goes to 0

Human	Automation	SAE 0	SAE 1	SAE 2	SAE 3	SAE 4	SAE 5
			No automation	Driver assistance	Partial automation	Conditional automation	High automation
	Skill	128	127-114	114			
	Rule	254	255-250	250			
	Knowledge	65	65-81	81			

		Automation	SAE 0	SAE 1	SAE 2	SAE 3	SAE 4	SAE 5	
Human		? = Higher levels involve unknown situations and definitions		! = Skill/rule may already deteriorate to knowledge, adding up to drivers' knowledge-behaviour			* = in case of an accident		
			No automation	Driver assistance	Partial automation	Conditional automation	High automation	Full automation	
	Skill	128	127-114	114	114-43				
Rule	254	255-250	250	250-69*-66					
Knowledge	65	65-81	81	81-34?!					

Human	Automation	SAE 0	SAE 1	SAE 2	SAE 3	SAE 4	SAE 5
	? = Higher levels involve unknown situations and definitions		! = Skill/rule may already deteriorate to knowledge, adding up to drivers' knowledge-behaviour			* = in case of an accident	
	No automation	Driver assistance	Partial automation	Conditional automation	High automation	Full automation	
Skill	128	127-114	114	114-43	40-0?	39-0?	
Rule	254	255-250	250	250-69*-66	51-29?	29-0?	
Knowledge	65	65-81	81	81-34?!	0-?!	0?	

Automated cars and human behaviour: not a happy marriage (yet)

Learn how to:

- Maintain attention
- Anticipate
- Collaborate
- Etc.



Automated cars and human behaviour: not a happy marriage (yet)

Learn how to:

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Design how to:

- Maintain attention
- Anticipate
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- Etc.



Automated cars and human behaviour: not a happy marriage (yet)

Learn how to:

- Maintain attention
- Anticipate
- Collaborate
- Etc.

Design how to:

- Maintain attention
- Anticipate
- Collaborate
- Etc.

A: Learn, train, educate

B: Design, create, facilitate



Tailor-made or tailor-taught?

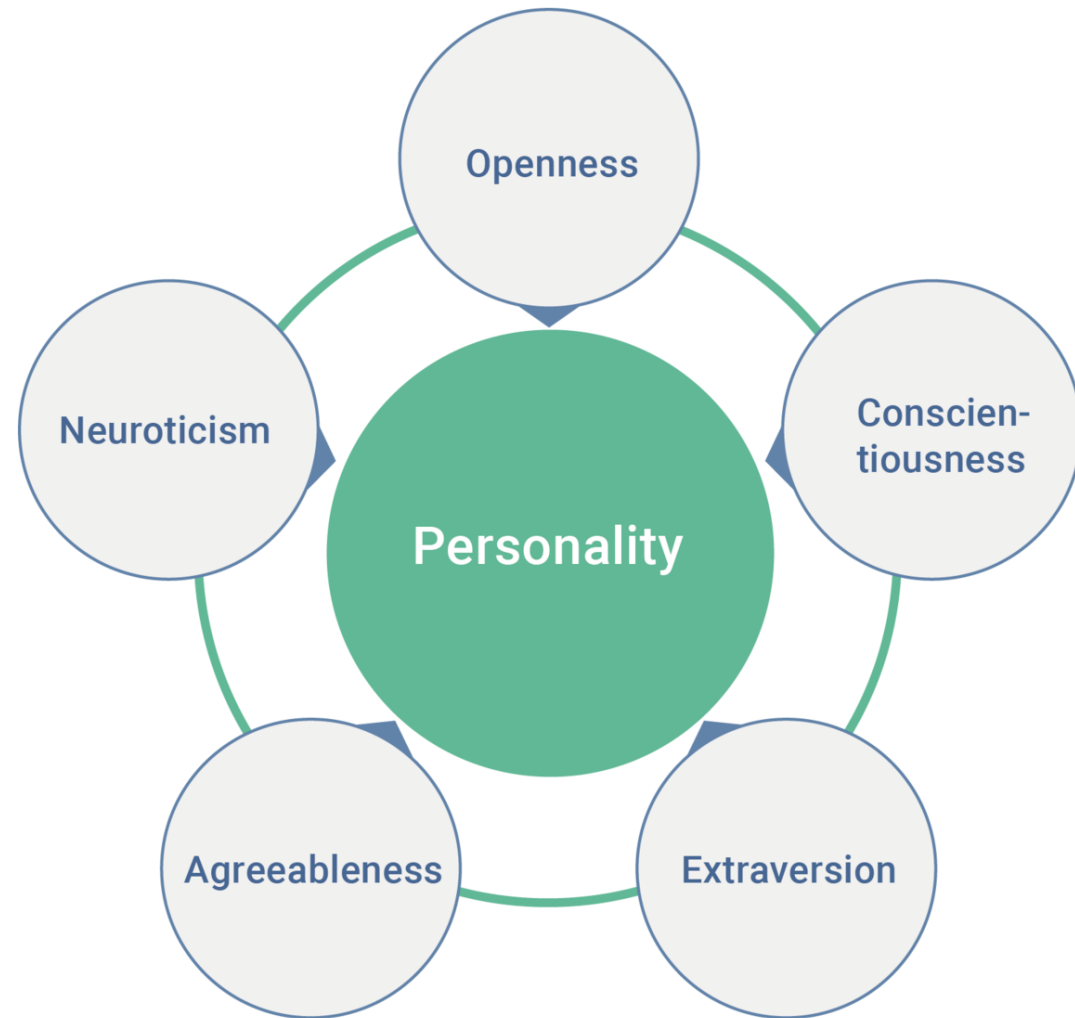
Individual differences in ADS



Large individual differences in take-over time (up to 30s for 90th percentile)
(Eriksson & Stanton, 2017)

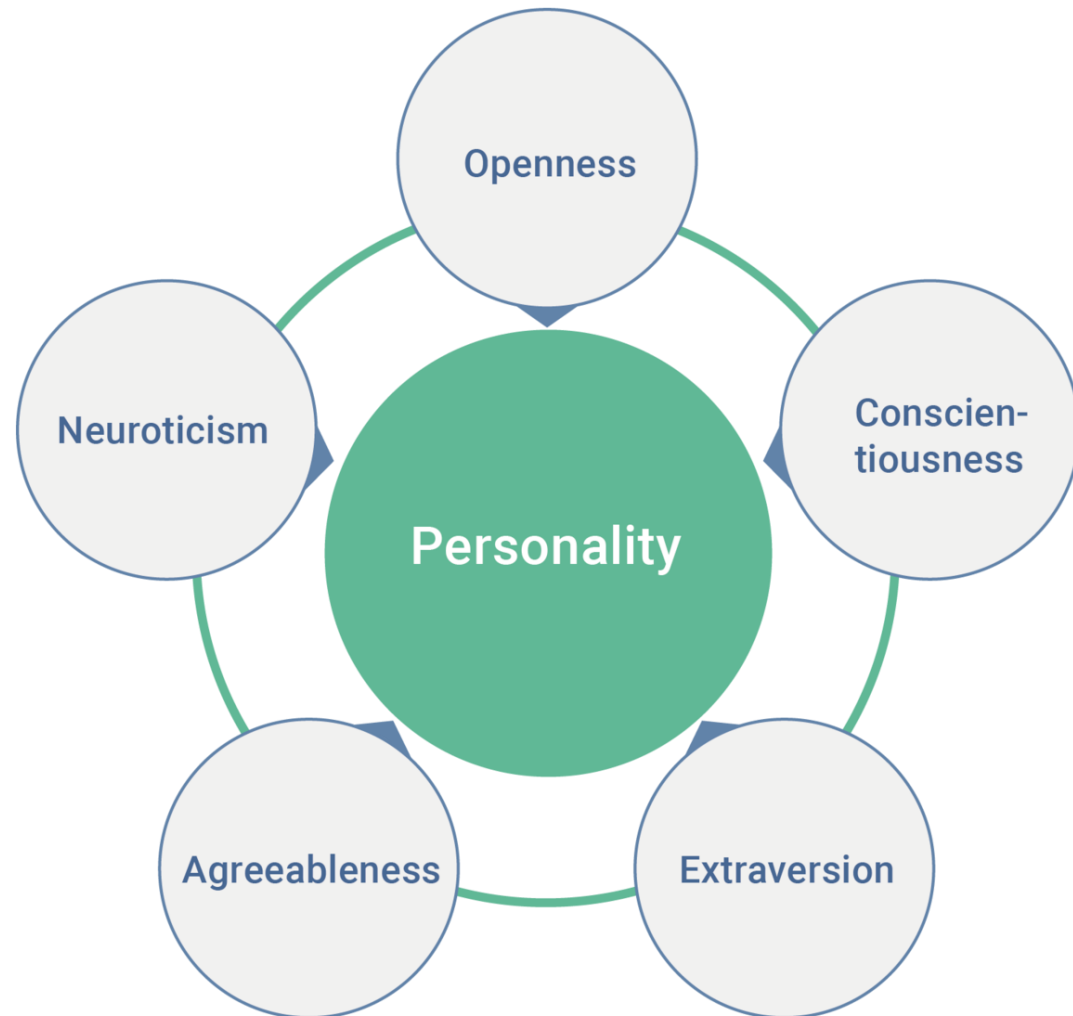
Individual differences in manual driving, e.g., extravert people drive angry
(Taubman-Ben-Ari & Yehiel, 2012)

Large scale simulator study (n=100+) on personality in ADS



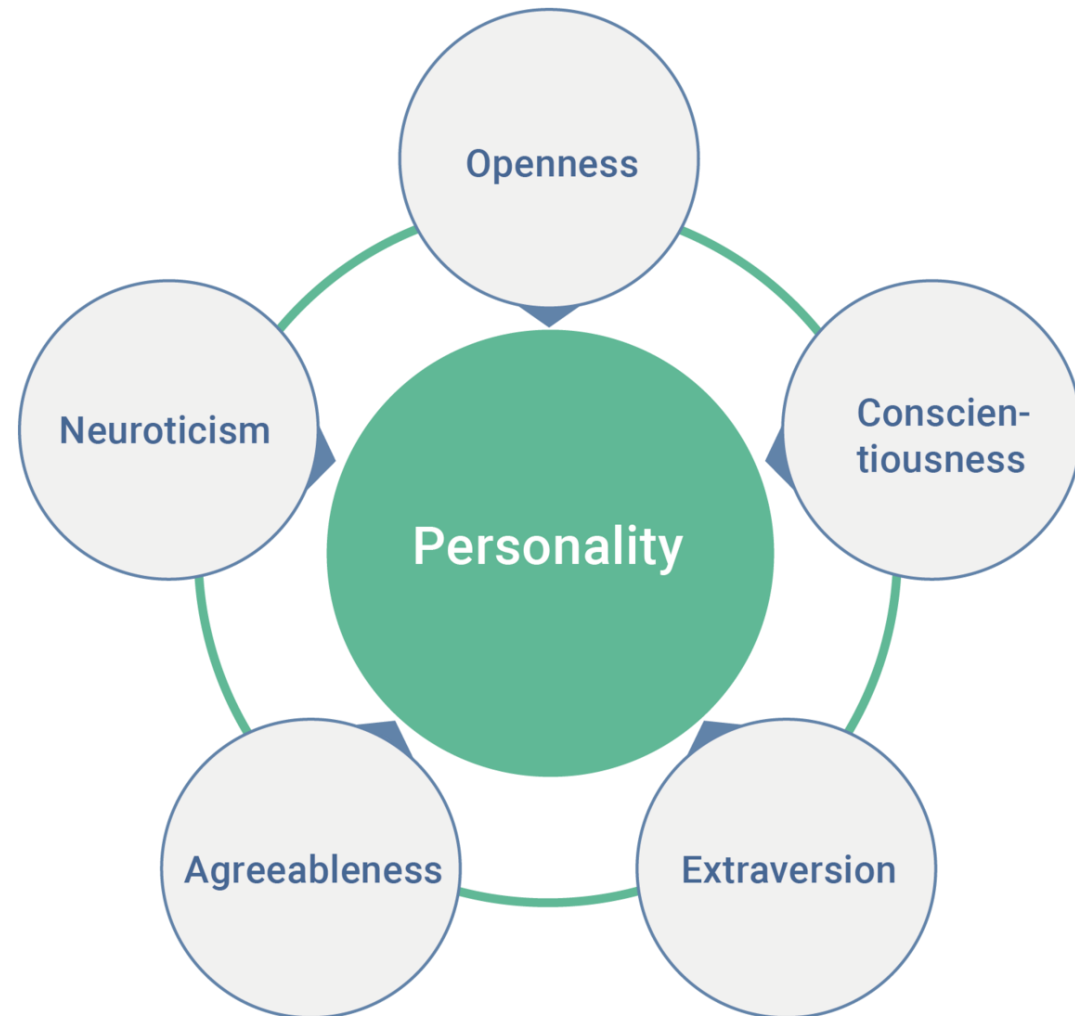
Large scale simulator study (n=100+) on personality in ADS

- Individualisation through Big Five Traits



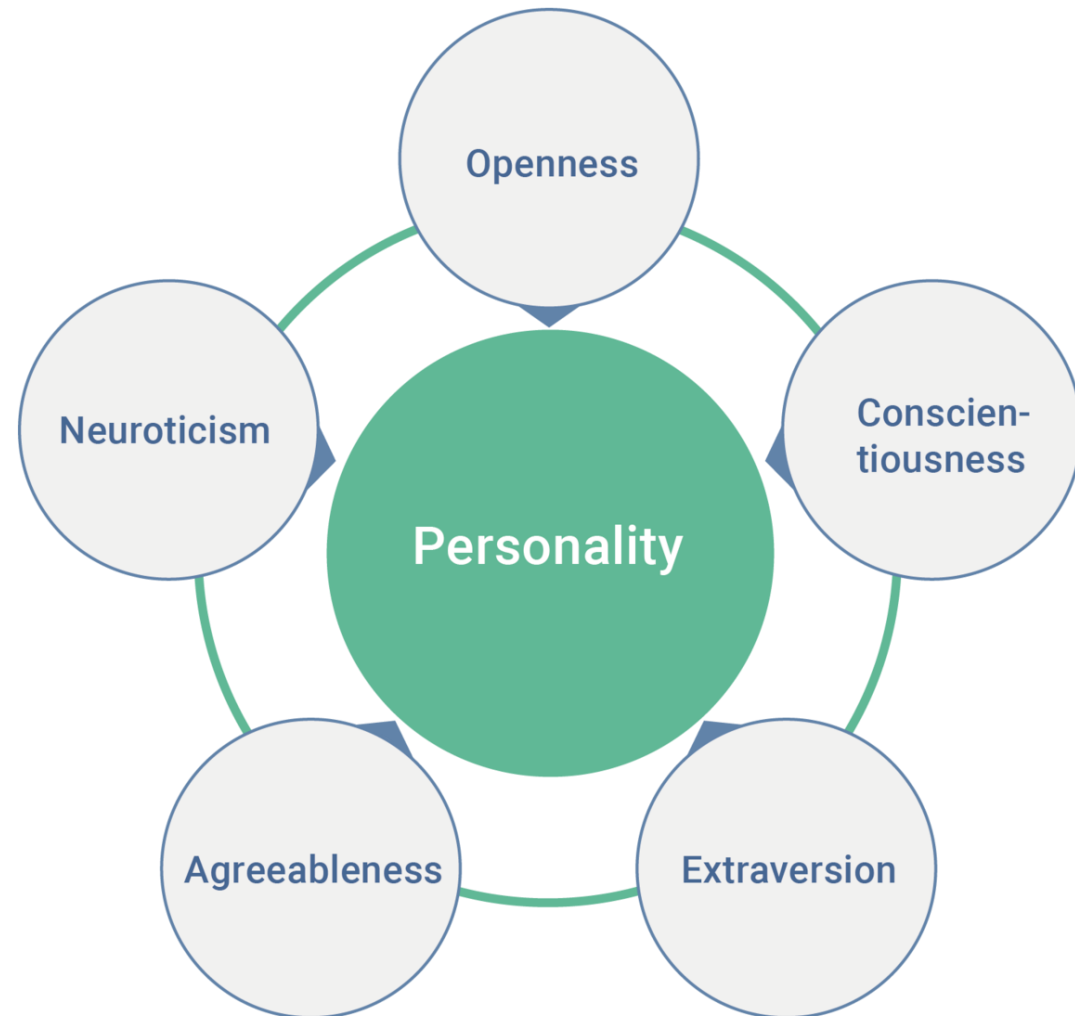
Large scale simulator study (n=100+) on personality in ADS

- Individualisation through Big Five Traits
- Initial step to tailored ADS



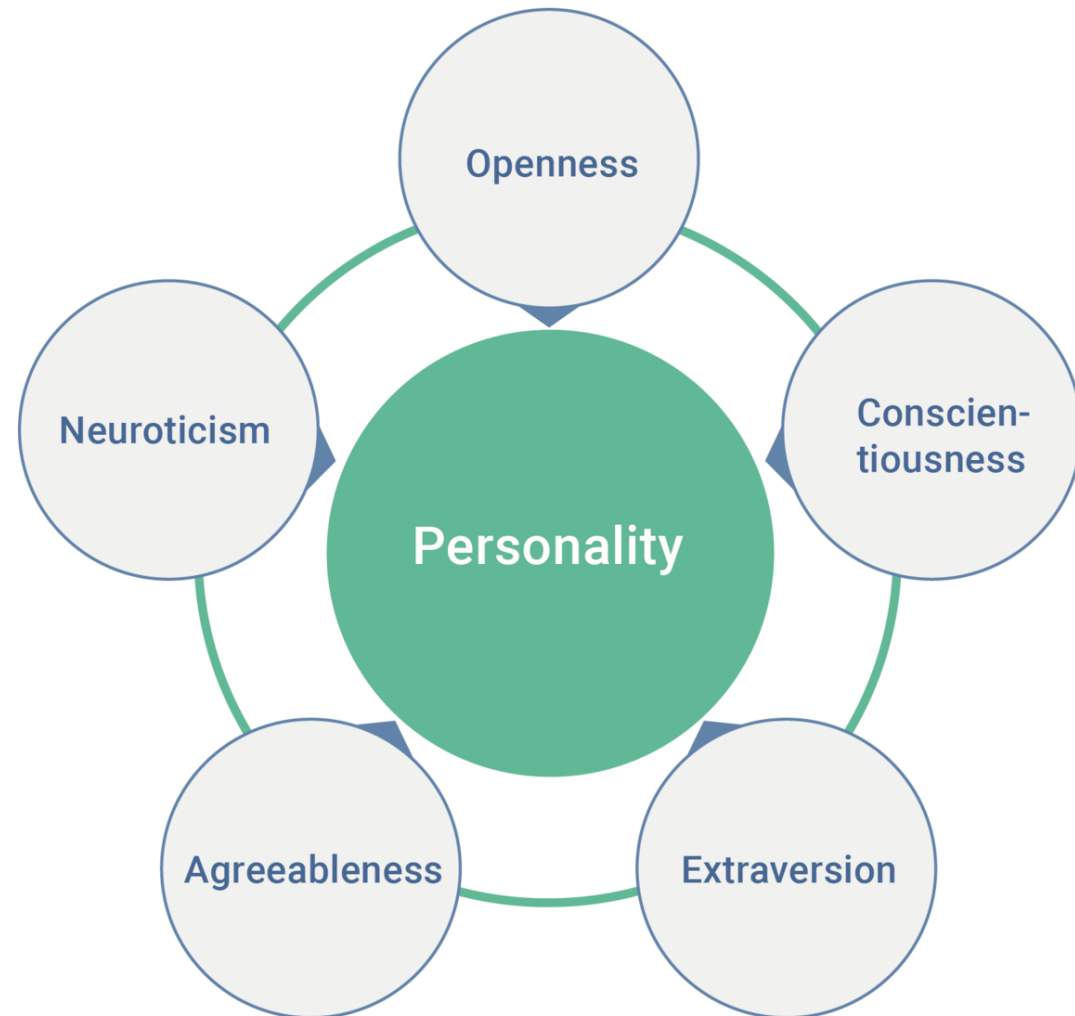
Large scale simulator study (n=100+) on personality in ADS

- Individualisation through Big Five Traits
- Initial step to tailored ADS
- Can we find personality differences?



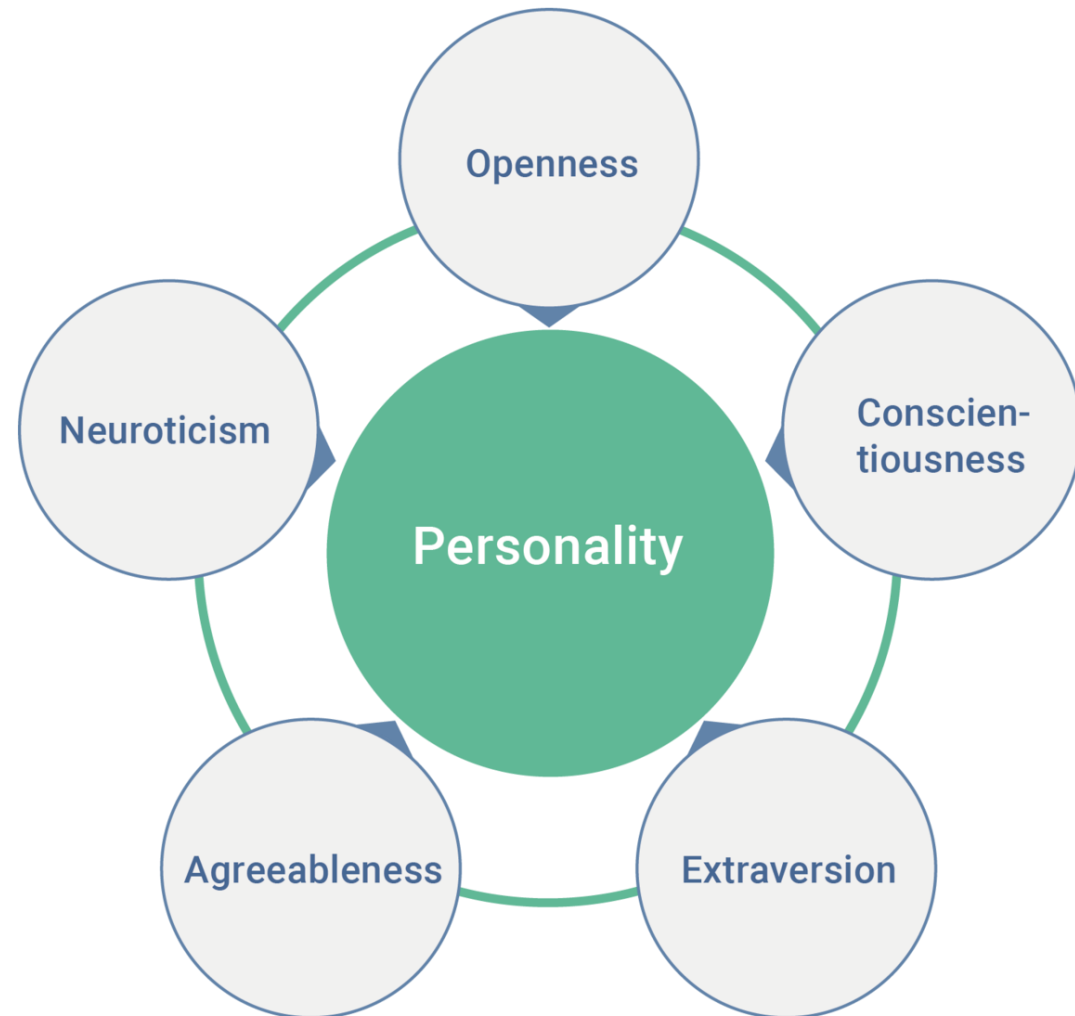
Large scale simulator study (n=100+) on personality in ADS

- Individualisation through Big Five Traits
- Initial step to tailored ADS
- Can we find personality differences?
- Various driving metrics, scenarios, take-over requests, etc

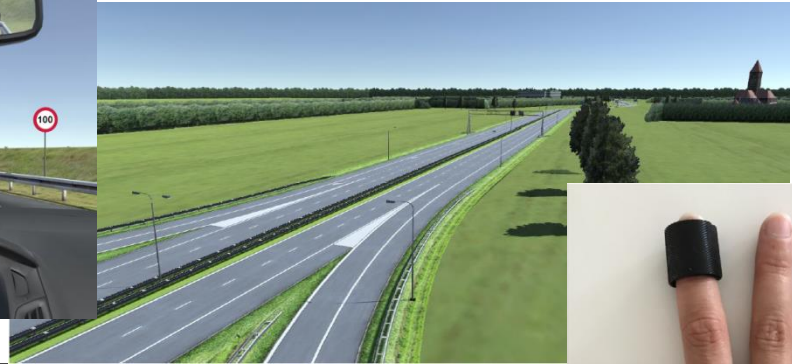


Large scale simulator study (n=100+) on personality in ADS

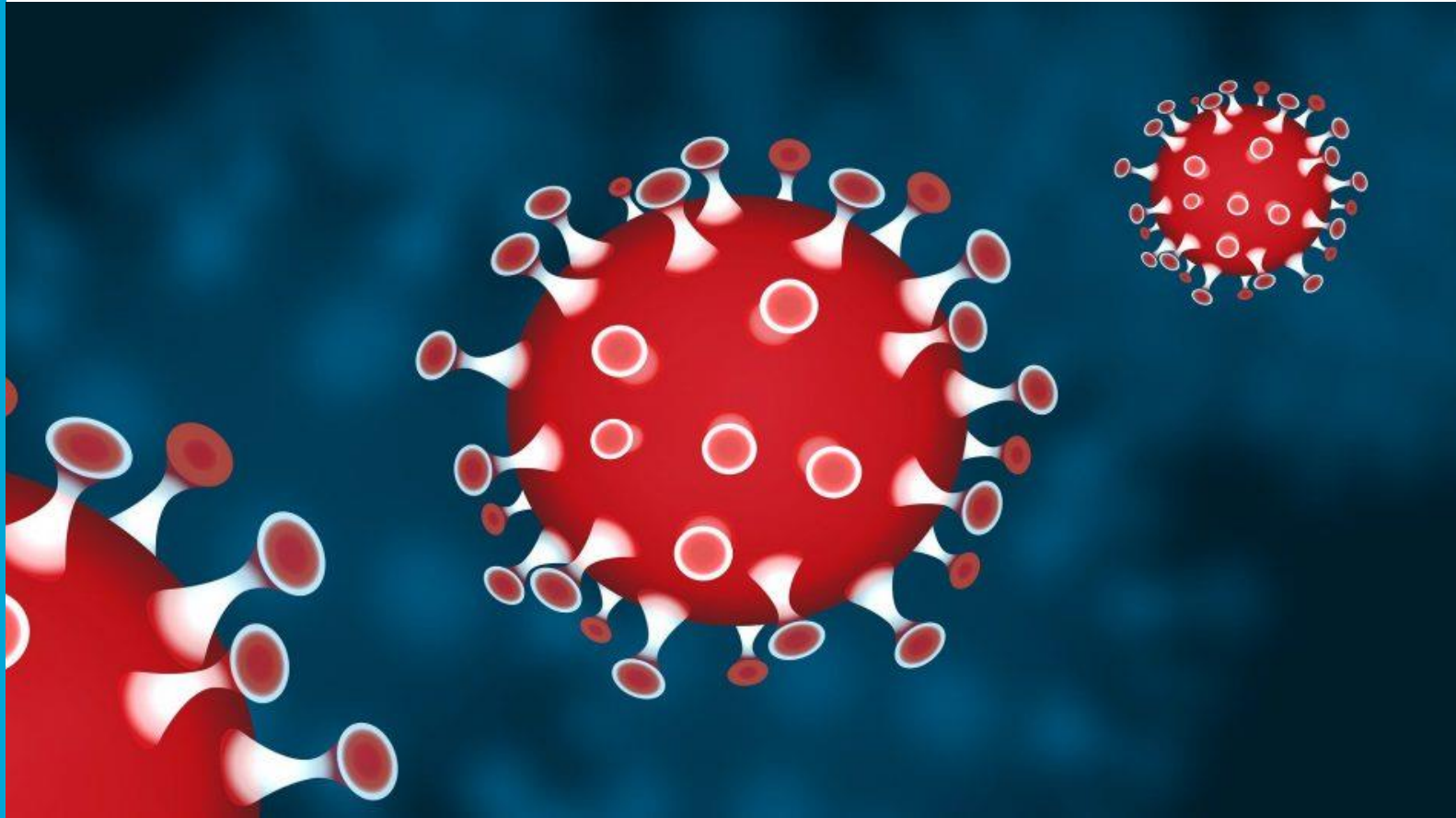
- Individualisation through Big Five Traits
- Initial step to tailored ADS
- Can we find personality differences?
- Various driving metrics, scenarios, take-over requests, etc
- Individualisation is meaningful



Large scale simulator study (n=100+) on personality in ADS



...and then corona happened...



Now what?



N=1 simulator study: validating the N=100+-setup



N=1 simulator study: validating the N=100+-setup

- 2 researchers as own subject
- Testing variables
 - $3*3*3*3=81$ and $4*4*4=64$ variations (runs)
- Which value of which variable is most effective?



N=1 simulator study: validating the N=100+-setup

Preliminary results

- **Validation (definitely) worthwhile**
- **TOR location important (no curves!)**
- TOR time budget has effect on HR (and is persistent)
- **Level of urgency is distinguishable in TOT
(and in temporal demand and errors)**
- Speech-rate nuances are not (too) relevant
- Some attention should be paid to signal words
(e.g., Warning vs Attention)
- **Lane width can have serious consequences for lane deviation**
- **Keeping lane has a serious learning curve**
- Learning effect on secondary task

Also done/doing:

- Systematic review on HMIs in ADS [**nearly completed**]
- Recruitment algorithm for ultimate BFI distribution
[completed]
- Analysis initial data of recruited participants [**completed**]
- Online questionnaire on trust in automation [**completed**]
- Operationalisation of trackability: empirically assessing condition of MHC (on-road -> online questionnaire)
[ongoing]
- Personality effects on take-over performance in ADS (on-road -> cancelled) [**cancelled**]
- Mental models on transition of control [**ongoing**]

Thank you!
Questions?

