Evaluating Simulated Risky Traffic Situations Designed to Meet the Goals for Driver Education

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Background

- Driver risk perception is hard to assess
- Today's system of driver tests may let risky drivers trough
- A driving simulator can detect drivers who consider themselves ready for a driving test, but have not achieved the risk awareness required to be a safe driver
- Situations included should be critical and appropriate to capture risk awareness and, to complement the driving test, be difficult to attempt in a driving test
- Each situation must have clear criteria for pass or fail, so that the screening test can be fair and not require any interpretation of the results

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Driver education in Sweden

- Practice driving private or in traffic school
- Theoretical test, risk education and practical driving test
- Simulators are established tools in professional driver education and are now becoming more common in traffic schools
- The curriculum is based on the Goals for Driver Education (GDE) framework (Hatakka et al, 2002)

GDE-framework

(Hatakka et al. 2002)

The suggested driving simulator screening test has proven efficient in finding risky drivers, however the relation to the GDE framework has not been evaluated yet

(GDE Matrix – Goals for Driver Education)

Levels / Area	Knowledge and skills	Risk increasing aspects	Self assessment
Goals for life and skills for living 4	Lifestyle, age, group, culture, social position etc, vs. driving behaviour	Sensation seeking, Risk acceptance, Group norms, Peer pressure	Introspective competence, Own preconditions, Impulse control
Goals and context of driving 3	Modal choice, Choice of time, Role of motives, Route planning	Alcohol, fatigue, Low friction, Rush hours, Young passengers	Own motives influencing choices, Self-critical thinking
Driving in traffic 2	Traffic rules, Cooperation, Hazard, perception, Automatization	Disobeying rules, Close-following, Low friction, Vulnerable r.u.	Calibration of driving skills, Own driving style
Vehicle control 1	Car functioning, Protection systems, Vehicle control, Physical laws	No seatbelts, Breakdown of vehicle systems, Worn-out tyres	Calibration of car-control skills

Aim and research question

This questionnaire study aimed to evaluate the simulator screening test situations in relation to the GDE framework by answering the research question:

- To what extent are the various levels of the GDE framework represented in the test situations?

Method

- 89 driver education professionals with at least one year of experience working with the GDE framework completed a questionnaire
- The questionnaire consisted of 15 depicted and described traffic situations, presented in a randomized order for each participant
- Each situation was accompanied by the following questions, representing various levels of driving behavior specified by the GDE framework, to be answered on a scale of importance (0-100 %):

How important do you think this is for the driver to handle the situation well?

- **Level 1 (*vehicle maneuvering*):** To be able to handle the vehicle, the driver must have sufficiently good maneuvering skills and knowledge of how things such as speed, brakes, and road conditions affect, for example, the vehicle's braking distance.
- **Level 2 (*mastering traffic situations*):** To be able to handle a situation, it is necessary that the driver detects other road users, understands the obligations of both other road users and the driver himself, and interprets their behaviour in a correct way.
- **Level 3 (*goals and context of driving*):** To handle a situation, a driver should predict possible scenarios during the journey and manage stress and fatigue.
- **Level 4 (*goals for life and skills for living*):** Resisting temptation and peer pressure makes it easier to make wise decisions in different traffic situations. At the same time, your goals in life affect when, where and how you choose to drive.

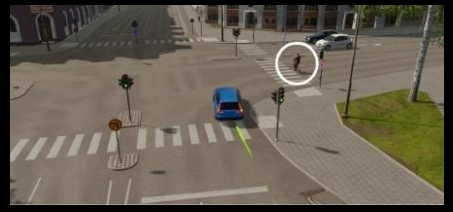
Situations

1: Left turn with oncoming traffic

2: Traffic queue with pedestrian

3: The driver must give way to the bus

4: Child is running towards crossing

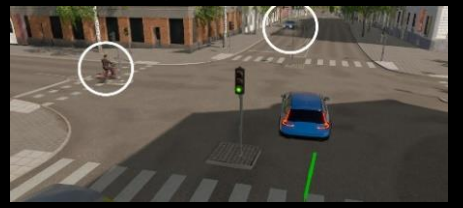


5: Bicycle crossing the road in junction

6: Pedestrian partially hidden

7: Child runs out from in front of a bus

8: Adapt speed to highway traffic



9: Bicycle crossing and oncoming traffic

10: Truck parked behind a small hill

11: Car is hidden behind turning bus.

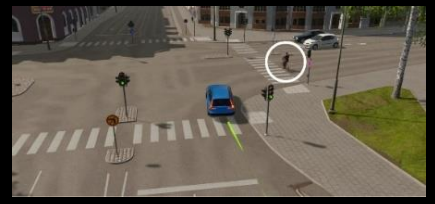
12: Slow vehicle enters the road

13: Adapt speed to highway traffic

14: Moose enters the road

15: Left turn from a high-speed road

Results

Situation	Rating per GDE- level: Mean (*SD*)	Situation	Rating per GDE- level: Mean (*SD*)	Situation	Rating per GDE- level: Mean (*SD*)
	1: 79.6 (24.1) 2: 92.3 (10.9) 3: 79.8 (22.5) 4: 70.8 (27.4)		1: 77.0 (25.5) 2: 92.6 (13.6) 3: 91.2 (12.3) 4: 71.5 (28.5)		1: 68.8 (27.1) 2: 92.0 (13.4) 3: 86.3 (17.1) 4: 68.51 (28.6)
1: Left turn with oncoming traffic		2: Traffic queue with pedestrian		3: The driver must give way to the bus	
	1: 79.7 (25.2) 2: 96.1 (8.9) 3: 86.4 (19.6) 4: 71.3 (30.8)		1: 71.1 (28.8) 2: 94.5 (10.7) 3: 83.6 (18.4) 4: 63.4 (31.8)		1: 72.1 (29.8) 2: 93.1 (12.8) 3: 87.1 (18.6) 4: 67.7 (31.4)
4: Child is running towards crossing		5: Bicycle crossing the road in junction		6: Pedestrian partially hidden	
	1: 84.6 (22.8) 2: 93.8 (11.0) 3: 89.2 (14.0) 4: 75.1 (27.8)		1: 89.3 (15.2) 2: 92.3 (11.3) 3: 81.7 (22.7) 4: 71.6 (30.2)		1: 71.1 (26.1) 2: 94.1 (10.5) 3: 86.0 (19.4) 4: 67.7 (31.1)
7: Child runs out from in front of a bus		8: Adapt speed to highway traffic		9: Bicycle crossing and oncoming traffic	
	1: 80.9 (21.8) 2: 88.5 (16.4) 3: 85.9 (18.8) 4: 70.5 (28.9)		1: 63.2 (33.4) 2: 92.1 (12.7) 3: 88.1 (17.1) 4: 72.9 (28.4)		1: 86.3 (17.2) 2: 88.3 (16.1) 3: 80.8 (20.6) 4: 73.2 (26.7)
10: Truck parked behind a small hill		11: Car is hidden behind turning bus.		12: Slow vehicle enters the road	
	1: 86.7 (16.6) 2: 92.7 (11.8) 3: 81.6 (19.0) 4: 69.8 (29.0)		1: 84.8 (24.5) 2: 67.8 (33.4) 3: 90.9 (14.3) 4: 67.7 (33.0)		1: 85.9 (19.1) 2: 93.8 (10.3) 3: 87.1 (16.8) 4: 76.2 (29.1)
13: Adapt speed to highway traffic		14: Moose enters the road		15: Left turn from a high-speed road	

Discussion

- The high ratings (mean ratings over 63%) on all GDE levels of driving behavior indicate that every level is represented in each situation, regardless whether the hazard present in the situation is explicit or obscured.
- With one exception, all situations were rated highest on level 2 (*mastering traffic situations*) compared to the other levels, which includes skills like detecting other road users, understanding obligations, and interpreting behavior.
- The exception was the situation in which a moose enters the road, which requires good scenario prediction (level 3) and maneuvering skills (level 1).
- The three situations involving speed adjustment stand out with higher ratings on level 1 compared to level 3.

Conclusion

- All driving behavior levels of the GDE framework are well represented in the simulator screening test situations, suggesting the test is a suitable complement to the on-road driving test.
- The next step in this project will investigate how to generate a sufficient amount of variations of the test situations to ensure that test takers cannot predict what situations will occur.