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CONGRESS**
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Training and testing hazard awareness on a simulator. Results of a longitudinal study

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Training and testing hazard awareness



During training and testing, student drivers demonstrate what they **can do**, not what they (habitually) **do** after obtaining a license (Evans, 2004).

Research suggests that adding a theory test does not improve road safety, whereas adding a hazard perception test does (SWOV, 2025).

Training for the Unexpected: Enhancing Driver Preparedness Through Hazard Awareness.

A 15-Year Cohort Study in the Netherlands

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A 15-Year Cohort Study in the Netherlands



- Vlakveld (2011) demonstrated in the SimRapt experiment that simulator-based hazard-anticipation training improved visual search (detection) of latent hazards.
 - Whether this effect persisted over an extended period was not investigated, as participants were tested within an hour of the training.
- In 2013, Green Dino introduced a simulator-based hazard-awareness training program, drawing on the SimRapt scenarios developed by Vlakveld.
 - Green Dino aimed to improve the detection and anticipation skills needed for hazard awareness.

A 15-Year Cohort Study in the Netherlands



- The dataset comprises simulator scores from student drivers who underwent simulator training between 2008 and 2023, as well as responses to two questionnaires.
- Simulator data were collected from 33 driving schools across the Netherlands using four different types of simulators.
- After filtering, the simulator and questionnaire data of **2,372** participants remained for analysis.
 - Of these, 911 (38.4%) identified as male and 1,460 (61.6%) as female; one participant did not report gender. Males had a mean age of 24.4 years and females 24.1 years.
 - 106 (4.5%) were 17–18 years old, 1,301 (54.9%) were 19–23 years old, and 963 (40.6%) were 24 years or older.
 - 70.6% held a higher education qualification (University of Applied Sciences or Research University), while 28.3% had lower levels of education (Secondary Vocational Education or below).

A 15-Year Cohort Study in the Netherlands



- To study the effects of Hazard Awareness Training, data were divided into two groups: an **HAT** group and a **No HAT** control group. Both followed automated simulator training and 2 simulator tests for vehicle handling and crossing intersections (No Hat 6,15 hours - HAT 7,50 hours).
- The HAT group comprised student drivers who completed both **Hazard Detection Training** and Testing (HDTT) and **Hazard Anticipation Training** and Testing (HATT). HDTT focuses on error-reduction training for standard viewing procedures — where to look — with direct visual and audio feedback.
- HDTT and HATT **separately showed no significant effects.**

Hazard Detection Training and Testing (HDTT)



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Hazard Anticipation Training and Testing (HATT).



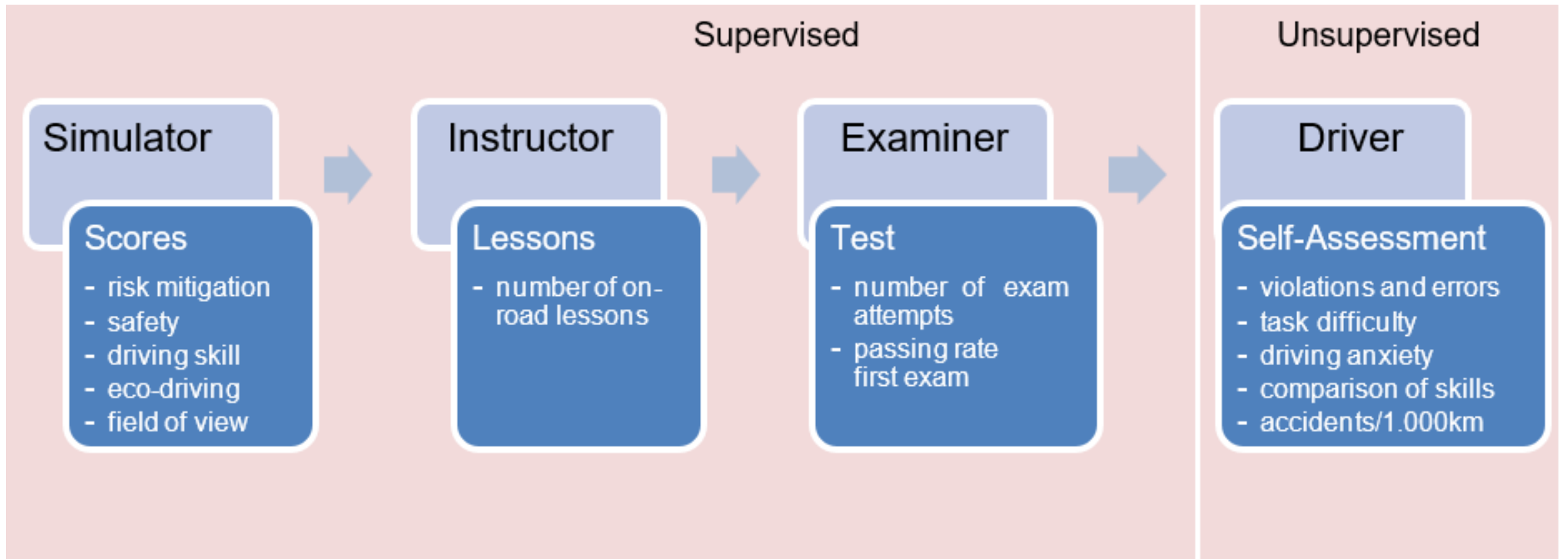
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A 15-Year Cohort Study in the Netherlands

– Measures were taken from four periods of driving.

The self-assessment is studied for four periods of unsupervised driving: (i) the first six months, (ii) seven to twelve months, (iii) the first twelve months, and (iv) the last twelve months. The last twelve months did not overlap with the other periods.



Highlights



- The combination of **error-based training on viewing procedures** and **virtual crash scenarios** was essential for achieving positive effects.
 - The HAT group needed 12.4% less on-road lessons, and the success on the first exam was 24.1% higher.
- Hazard awareness simulator training improved simulated and supervised driving, **but this effect did not persist in driving unsupervised (after licensing)**.
- The simulator, driving instructor and examiner **assessments align**.
- **Personal characteristics** showed **stronger and more persistent** associations with unsupervised driver performance than training measures.

Lessons learned



- **lower-order skill training** (applying higher safety margins) will affect road safety more positively than higher-order skill training.
- Instructors do not follow up the simulator curriculum on-road, instructing **lower safety margins**; fluent driving and the hand-over steering method (both stimulate tunnel-vision).
- Examiners **penalise** students who drive with **higher safety margins**: women, higher educated, older.

PhD research: Journal articles



- Kuipers, J., De Winter, J.C.F., & Mulder, M. (2023). **From fear to forecast: The role of simulators, accompanied driving, age, gender, and information-processing style in driver training and beyond.** *Transportation Research Part F: Traffic Psychology and Behaviour*, 99, 389–407.
- Kuipers, J., Mulder, M., & Voskes, M. (2026). **Training for the unexpected: Enhancing driver preparedness through hazard awareness — a 15-year cohort study.** *Accident Analysis and Prevention*, 232, 108536.
- Kuipers, J., & Mulder, M. (2026a). **Simulator sickness, within-session skill erosion, and the detection paradox in Code 95 professional driver training (N = 5,836).** [Manuscript in preparation.]
- Kuipers, J., & Mulder, M. (2026b). **The certification paradox: Why raising thresholds cannot improve post-certification safety — Mental Transition, Differential Supervisory Response, and the Data Loop.** [Manuscript in preparation.]

Future research

1. A pre-registered multi-school cohort extension. The existing test battery must be deployed at a representative network of Dutch driving schools beginning in 2026. A study beginning in 2028 cannot inform the 2029 legislative processes.
2. **European multi-country replication.** A common test battery and shared outcome metrics across five to eight Member States would provide the first cross-national longitudinal dataset on post-licensing safety as a function of integrated simulator training.
3. A quasi-experimental comparison of integrated versus current-architecture training.
 - Schools implementing the integrated simulator-on-road curriculum serve as the treatment condition; matched schools continuing the current sequential architecture serve as the control
4. Differential Supervisory Response profile validation against BIS/BAS scales (Gray & McNaughton, 2000)
 - Profile 1: overactive supervisory control stimulated by fear – Profile 2: inactive supervisory control by automation
5. ADAS-based EOS detection in the first two post-licensing years, closing the open feedback-loop after licensing.
6. Extension to populations with identified information-processing constraints — ADHD and ASD

Questions

Interested in **future research** and/or my PhD Thesis: j.kuipers@greendino.nl





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