

## A “thinking road surface”

---

*Dick de Waard<sup>1</sup>, Karel A. Brookhuis<sup>1</sup>, Magrita C. Noordmans<sup>2</sup>,  
Jeroen H. Hogema<sup>3</sup>, and Rob M. Visscher<sup>4</sup>*

*<sup>1</sup>Department of Psychology  
University of Groningen*

*<sup>2</sup>Verenigde VTN Bedrijven*

*<sup>3</sup>TNO Human Factors*

*<sup>4</sup>Ministry of Transport, Roads to the Future project  
The Netherlands*

### **Abstract**

Comprehensibility of an assistance system that should facilitate merging at places where a motorway lane ends was evaluated in the advanced driving simulator of the University of Groningen. Main components of the system called “Denkdek” (“Thinking road surface”) are electronic speed limit signs, arrows stimulating to merge, and moving light (LED) bars embedded in the road surface of the emergency lane. The system is made for motorways with a left lane drop. Goal of the system is to reduce speed and speed variability between lanes, and to introduce a small speed difference between the lanes. Drivers on the right-hand lane (i.e. the lane next to the emergency lane) should drive next to a moving LED-light bar and make space for traffic on the centre lane so they can merge. The space these vehicles leave behind on the centre lane can be used by vehicles on the left-hand lane.

Results showed that the system was effective in reducing speed, and on the right-hand lane average time-headway to cars-in-front increased. More traffic merged from centre to right if the system was switched on and in this way space on the centre lane was created. Drivers merged earlier compared with the situation where the system was off. This effect was also found with drivers who drove on the left-hand lane. In contrast, if the system was switched off a large proportion of drivers remained on the centre lane. Drivers judged driving *without* the system to be easier and smoother. Rides on the centre and right-hand lane were considered to be less effortful without the system. Rated acceptance of the system was neutral, usefulness of the system was evaluated as slightly positive. A high proportion (41%) mentioned potential distraction from other traffic by the system, and more than one in four said they ignored the system. Participants reported that the behaviour they were expected to display was neutral to clear. The driving simulator study has been followed by a field trial, which is at present being conducted.