

Abstract

Drowsiness warning systems are a relatively new kind of driver assistance. In their development so far, there was an articulate research focus on the problem of drowsiness detection. Little is known about how effective these systems actually are in reducing the risk of drowsiness-related accidents and about what aspects of warning design are crucial in achieving the desired effect on safety.

As to the critical driver state, only a reduction in drowsiness can effectively mitigate the safety risk. Therefore the objective of a warning is to convince the driver to take a break during which he should ingest caffeine and / or take a short nap. However, on the level of beliefs, attitudes and motivation, a number of psychological processes counteract this desired behavior. There are two tendencies that represent a particular challenge to warning effectiveness: the optimism bias in the appraisal of personal risk and the tendency to avoid immediate subjective response costs associated with a break.

Against this background, the current studies examined the effect of different warning alternatives on cognitive, motivational and behavioral variables. For this purpose, a new experimental paradigm was developed for reproducing, in the driving simulator, the constellation of incentives typical of a real warning situation. A high initial level of drowsiness was induced among participants by partial sleep deprivation and by exploitation of circadian lows in performance. In addition, a constellation of potential gains and losses was created to emulate the most important elements of driver motivation in a real warning situation. Driver state was monitored during simulated drives on a monotonous road. At meeting a defined drowsiness criterium, drivers were given one of several feedback variants. Experiment 1 compared two warning alternatives: a standard warning (coffee cup symbol) and a warning involving an image of the driver derived from the current situation, which was newly developed with focus on high persuasiveness. On the level of behaviorally relevant beliefs, the group of drivers warned by means of their own image scored higher on subjective vulnerability as well as perceived effectiveness of a break. Overall, the incidence of breaks was extremely low however. In Experiment 2, the incentive conditions were exacerbated, and the effects of either warning alternative were compared to a situation without any warning system. It turned out that the standard warning affected subjective vulnerability and break frequency in the expected direction, but only to a very small extent. The warning involving the driver image consistently entailed larger effects on behaviorally relevant beliefs and observable breaks. Moreover, in both experiments, the situational context of the warning was varied by displaying it either in close proximity to the destination or at a larger distance to go. As expected, close proximity to one's destination had adverse effects on motivation to take a break and observable breaks.

The results provide initial evidence as to how the safety effect of drowsiness warning systems can be enhanced by greater consideration of the persuasive and motivational functions in warning design. Alongside the development of detection technology, future empirical research should be directed to a greater extent at the measurable effectiveness of warnings and the mediating psychological processes in order to optimize not only the input, but also the output of drowsiness warning systems.

Key words: drowsiness detection, drowsiness warning, persuasion, motivation, optimism bias, fatigue management