

Monotony & hypovigilance



- Monotony is a growing problem and contributing factor to road crashes.^{1,2}
- Monotony leads to an important vigilance impairment, independent of driver fatigue,¹ in as little as 20 minutes of driving.^{1,2}
- No efficient countermeasures currently exist to combat the effects of monotony.³

State of the Road A Fact Sheet of the Centre for Accident Research & Road Safety - Queensland (CARRS-Q)

THE FACTS

What is monotony?

- A monotonous driving task occurs when stimuli are constant, predictable or highly repetitive.
- Monotony can be attributed to the repetitiveness of the actual driving task (as experienced by professional drivers who are behind the wheel for long periods), or a lack of stimuli in the road environment (as found in long straight stretches of dual carriage highway or rural roads).⁴

What is hypovigilance?

- Hypovigilance refers to a driver's decreased alertness and attentiveness.
- "Boredom", "drowsiness" and "highway hypnosis" are factors leading to hypovigilance.^{1,2}
- Road monotony leads to driving behaviour impairment comparable to that observed when a driver is fatigued. Driver hypovigilance is often attributed to fatigue, but can emerge independently of time on task and despite a driver being well rested.
- Driver hypovigilance could occur more frequently in monotonous road environments.⁵
- Monotony leads to an important vigilance impairment. Performance decrements associated with monotony emerge early, after less than 20 minutes of driving.^{1,2}

Why are monotony and hypovigilance a problem for road safety?

- A new type of road crash has emerged due to contemporary road safety interventions which oversimplify the driving task.^{1,2}
- The very measures put in place by infrastructure authorities to reduce road

crashes might be contributing to one of the causal factors of road crashes, namely monotony. Simplification of the driving task to a mere lane-keeping one, road modifications such as removal of road curves, and driving assistance systems such as cruise control and power steering, all conspire to reduce the number and variability of stimuli the driver engages with. As a direct consequence, the driving task has become increasingly monotonous. This increased monotony results in impaired information processing and a rapid deterioration of a driver's ability to react to unpredictable events (i.e. their vigilance).⁴ It can also lead to microsleeps during which the driver is actually asleep for a few seconds, while driving, with their eyes still open.^{2,6} All of these factors dramatically increase the likelihood of a road crash.

- Monotony and hypovigilance are especially dangerous as drivers are often unaware that their driving behaviour is impaired and continue to drive.^{3,7} "Inattention" was deemed the most important contributor (27%) to fatal and hospitalisation crashes in Queensland in 2003 (Queensland Transport, 2005),^{1,2} and fatigue is estimated to cause 20% to 30% of road crashes annually.³

If you experience "boredom", "drowsiness" or the feeling of "highway hypnosis" while driving, stop and take a break.

- Research suggests that monotony induces physiological reactions similar to those experienced when fatigued (e.g. increased drowsiness and decreased arousal). Monotony and fatigue crashes occur on good quality roads with few curvatures, at similar times (2-4pm and 10pm-6am), and are usually head-on collisions involving only one vehicle, with the vehicle hitting an obstacle without a reaction from the driver (assessed by the absence of skid marks at the crash scene). In a 1997 empirical review of driver fatigue incidents³, 27% of drivers having reported a fatigue-related road crash or incident did not feel tired prior to the crash. Most of these drivers were driving on well known, repetitive routes. This appears even more on rural roads where 45% reported they were not feeling tired at all prior to the fatigue incident where roads are highly monotonous. These findings raise the question of the role of the monotony of the driving task in explaining fatigue-related crashes.
- It is difficult to distinguish fatigue-induced from monotony-related crashes, thus there is a lack of accurate and available crash data to define the magnitude of the monotony road safety problem.^{1,2}
- Whilst the consequences of monotony and fatigue for road safety are quite similar (i.e. to decrease driver vigilance and increase crash risk), the concepts are quite different. Research shows that monotony increases driver fatigue,³ and monotony and hypovigilance can occur independently of driver fatigue⁸, thus monotony crashes require independent study and specific address.
- No efficient countermeasures currently exist to combat the effects of monotony.³

Who is most at risk?

- All drivers experience task and environmental monotony and the resultant effect of hypovigilance.
- Monotony-related incidents are reported more frequently on rural roads that are, by nature, highly monotonous: 45% of drivers reported not feeling tired at all prior to the fatigue incident.⁵
- Professional drivers are particularly at risk¹ due to their long repetitive hours behind the wheel and expansive travel routes.
- Interestingly, research indicates that individual differences such as sensation seeking and extraversion can negatively affect vigilance and performance in monotonous tasks.^{2,6} High sensation seekers may well be more affected by highly monotonous tasks and thus at increased risk for this type of crash.

TIPS FOR STAYING SAFE

- Be mindful of the impairing effects of hypovigilance caused by monotonous road environments and repetitive driving tasks. Be particularly alert to its dangers on rural roads, straight stretches and dual carriage highways where the road environment is repetitive and unstimulating.
- Be aware that monotony can impair your driving after less than 20 minutes.⁸ If you experience “boredom”, “drowsiness” or the feeling of “highway hypnosis” while driving, stop and take a break.
- Avoid driving at the danger times of 2-4pm and 10pm-6am. If you must drive at this time, be extra vigilant to your driving condition and be prepared to take breaks.
- Whilst “sleep and rest” are efficient for fatigue, they are not successful in stopping the drowsiness felt on monotonous roads. If you continue to feel drowsy despite taking a break, additional measures

may be required (e.g. further stops, or increased stimulus such as participating in conversation).

- Remember that monotony creates a vigilance impairment independent of fatigue. Don't assume you are safe just because you do not feel fatigued.

CARRS-Q'S WORK IN THE AREA

- Differential effects of monotony versus fatigue on driving performance and the effectiveness of detection methods.
- PhD Study (Rebecca Michael): An examination of monotony and hypovigilance independent of fatigue.²
- PhD Study (Grégoire Larue): Development of a methodology and Intelligent Transport System (ITS) able to predict driver lapses of vigilance under monotonous conditions.¹
- CARRS-Q's Advanced Driving Simulator enables researchers to study drivers in critical situations with a high degree of realism, advancing our understanding of monotony, hypovigilance and fatigue.
- Rural and remote road safety study.

FUTURE DIRECTIONS

Current road safety countermeasures still assume that hypovigilance results only from fatigue and time on task.⁵ CARRS-Q's research highlights monotony as a significant contributory factor to road crashes independent of fatigue, identifies particular personality types as being more susceptible to suffering hypovigilance in monotonous conditions, and highlights the Australian road environment as particularly dangerous for monotony and hypovigilance-related road crashes. These findings have important implications for saving lives, particularly on Australian rural road networks.

Future work in this area may focus on:

- Improving the amount of available crash data to assess the impact of monotony during driving.
- Fatigue research focuses on sleep deprivation and circadian rhythms. More research is needed on task and environmental monotony.^{1,2}
- Road design improvements to increase the demands of the driving task (i.e. addition of road curvatures and stimuli e.g. signage).³
- The design of a hybrid hypovigilance detection system that combines non-intrusive physiological measures with other behavioural (e.g. head pose) and vehicle based measures (e.g. lane deviation) could increase the accuracy of a driver's vigilance level assessment.
- Unfortunately, to our knowledge, no countermeasure exists to counteract the effects of task monotony on the driver's alertness other than changing the road design and increasing the demands of the driving task. The development of appropriate countermeasures is imperative. One considered promising line of research involves the presentation of stimuli to the driver to regain their attention. Past research has looked at the addition of visual elements on the edge of the road, and exposure to sound, playing on amplitude and frequency to increase wakefulness. Simulator-based testing has shown the efficiency of these measures to be shortlived.³ This highlights the necessity to develop a detector of driver vigilance impairment. Simulator-based research may hold the key. Different types of ITS technologies are being researched mainly using physiological devices such as the EEG, and functional near infrared spectroscopy (fNIRS). Systems to detect hypovigilance in real-time are also under investigation using artificial intelligence algorithms.³

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