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Lite Paper

European NCAP Driver State Monitoring Protocols: Prevalence of Distraction in Naturalistic Driving

This document provides a summary of the findings in the following paper:

Mulhall, M., Wilson, K., Yang, S., Kuo, J., Sletten, T., Anderson, C., Howard, M. E., Rajaratnam, S., Magee, M., Collins, A., & Lenné, M. G. (2023). European NCAP Driver State Monitoring Protocols: Prevalence of Distraction in Naturalistic Driving. *Human Factors: The Journal of the Human Factors and Ergonomics Society, 66*(9), 2205-2217. https://doi.org/10.1177/00187208231194543

Driver distraction is a major cause of motor vehicle crashes worldwide, due to factors such as mobile phones and complex infotainment systems, and an increased reliance on growing levels of vehicle automation. While regulations have been put in place to address this issue, real-time distraction management has not been technologically feasible until recently.

Driver state monitoring (DSM) using camera-based systems was introduced as a practical solution to detecting driver distraction. However, despite the rapid maturation of DSM technologies, widespread adoption in the automotive industry has been slow and primarily limited to high-end luxury vehicles.

In 2023, the European New Car Assessment Programme (Euro NCAP) implemented a DSM system Test and Assessment protocol, setting requirements based on detection difficulty and behavioural complexity. Driver distraction is a core component of the Euro NCAP protocol and classified in two broad categories: long distraction – single long glances away (LGA) from the road – and short distraction – shorter multi-glance distraction, also known as visual attention time sharing (VATS).

This study investigated the prevalence of these distraction behaviours as defined by Euro NCAP in naturalistic driving, which had not previously been examined, and analysed the application of the Euro NCAP guidelines in real-world driving scenarios.

This is important as Euro NCAP's protocol is not only driving adoption of DSM systems across the automotive industry, but setting the standard in minimal tracking requirements.

The study found that Euro NCAP defined distraction behaviours occur in naturalistic driving, with long distraction events occurring once every 1.1 hours and short distraction occurring every 4.8 hours.

Long distraction

Euro NCAP defines a single LGA as lasting 3 seconds or longer, and further sub-categorises it into whether they are looking at driving-related (e.g. rear mirror) or nondriving-related (e.g. infotainment system) regions in the vehicle.

Glances to nondriving-related regions of longer than 2 seconds double the risk of a crash, yet despite this long distraction events are a common behaviour. Research on LGAs to driving-related regions is less established, though long glances towards rear view mirrors appear to have a lower crash risk (and are potentially even protective).

However, implementing different time thresholds for driving-related and nondriving-related distractions requires the DSM system have a higher degree of accuracy in driver tracking. Differentiating between driving-related and nondriving-related regions is challenging, as they are often in close proximity.

Systems that cannot reliably distinguish between these glance regions will have to use the same 3-second threshold for both regions, which will result in more frequent alerts for driving-related distractions, negatively impacting the user experience.

Short distraction

VATS involves drivers splitting their attention between the road and a secondary task (such as mobile phone use). Euro NCAP's protocol defines it as a cumulative 10 seconds of looking away from the road within a 30-second window, where a driver does not return their gaze to the road for a minimum of 2 seconds.

VATS events are only required to include glances to nondriving-related regions. This means DSM systems that cannot distinguish between driving-related and nondriving-related glances may achieve full points for multi-glance VATS events, but only through also including driving-related regions.

This is likely to have a major negative impact on user experience, through delivering alerts to drivers who are looking at driving-related regions and almost tripling the overall alerting rate.

Lizard and owl glances

Euro NCAP's protocol requires detection of both 'lizard' and 'owl' glances to achieve maximum scores for distraction. Lizard glances involve minimal head movement, while owl glances are primarily made through movement of the head.

Tracking eye gaze is more challenging than head angle due to a smaller tracking target, but it is necessary to accurately detect certain glances, such as lizard glances (commonly associated with phone use).

More sophisticated DSM technologies tend to use a combination of head angle and eye gaze tracking, whereas less sophisticated systems may rely on tracking head angle alone.

The research suggests DSM systems that can only detect owl glances will miss a large proportion of distraction events, as lizard glances are more common. It is important to accurately monitor both types of glances, as they have different safety implications.

Drivers typically utilise lizard glance strategies (eye movement only) when engaging in long distraction.

Other distraction

There are distraction behaviours specified in Euro NCAP's protocol that were not tested in the study, including body lean behaviours and noise factors. These factors may affect a system's ability to detect distractions and impact the user experience.

Future research will examine how DSM of drowsiness and distraction affect driver crash risk and safety metrics in passenger vehicles. It is important to understand how DSM modifies driver behaviour and whether it enhances safety.

In commercial vehicles, research by Fitzharris et al. (2017) found that monitoring driver drowsiness and delivering in-cabin alerts when it was detected reduced drowsiness events by 66%. Driver perception and acceptance of DSM technology should also be considered.

Overall, the study highlights the importance of accurately tracking and differentiating between distraction events and the need for further research on the impact of DSM on driver behaviour and safety.

The implementation of DSM in accordance with Euro NCAP's protocol will result in a varying number of alerts, depending on tracking capability (lizard and owl) and the ability to distinguish driving-related from nondriving-related glance regions.