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Issues in interaction designs of train protection systems: the need to (re-)direct attention towards signals

The main task of today's train drivers is to monitor the route, detect signals and their states and execute longitudinal control accordingly. This requires constant vigilance and memorization of the applicable speed limits while having limited scope of action and a high level of routine.

Additionally, train protection systems serve to elicit forced emergency braking, when a train driver fails to react adequately.

These systems consist of track-side and on-board components monitoring defined train states, usually speed. The train drivers interact with these train protection systems via in-cab interfaces that provide feedback to their actions. Examples are the "PZB 90" interface which shows a yellow indicator light after the train driver acknowledges a caution-signal by pressing a button, or the "ETCS" interface which displays a calculated braking-curve towards a stopping point with colour-coded deviation warnings.

This information, however, does not discharge the train driver from proactively monitoring the route and signals. The choice for action needs to be made regardless of the system feedback since the emergency brake onset is not executed until after a critical state has been reached.

Nevertheless, train drivers admit acknowledging warnings without proper awareness of the actual conditions (Crick et al., 2004; McLeod, Walker & Mills, 2003).

Concerning this issue, interface design seems to be of major importance.

Applying the SEEV model (Wickens & McCarley, 2008) shows that display information is likely to be more salient and to require less scanning effort than monitoring the route during long block intervals (bottom-up scanning). Since train drivers state high trust in the protection systems (Giesemann, 2013) they might also assume the limited information area to reliably inform them of necessary braking maneuvers (expectancy and value; top-down scanning).

This may result in devoting more attention to the on-board interfaces instead of scanning route elements, which are by definition the primary and only "safe" source of information.

To counteract this effect we suggest an interface concept that requires anticipatory processing of signal information from the route monitoring task.