# Understanding human behaviour and decision-making at level crossings

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## SUMMARY

This work presents a collaboration between [an academic] and [industry partner] to help improve safety at level crossings by developing a deeper understanding of how people behave at them. Using the theoretical foundations of the Perceptual Cycle Model (Neisser, 1976) to generate behavioural insights from workshops, interviews and field observations, the work aims to create decision support tools for level crossing managers, engineers, safety teams and investigators. The resulting human factors toolkit will inform hazard analysis, system design and behavioural interventions that will put level crossing users—and their needs, goals and behaviours—at the centre of activities to improve system safety.

## KEYWORDS

Level Crossings, Perceptual Cycle Model, Human Behaviour, Decision-Making, Rail

### Problem statement

Whilst investments in technology, signage and awareness campaigns have reduced risks for all level crossing users, unsafe and non-compliant actions continue to be contributory factors to accidents and incidents. Understanding human behaviour at, and near to, level crossings is therefore a key component in accident prevention. And it's also an explicit regulatory expectation, specified in the Office of Rail and Road's Principles for Managing Level Crossing Safety (2021) which states that "*level crossing design should understand the needs and limitations of the user*" (page 8). The need to adopt a human-centred risk-based approach to the management of level crossing safety is clear – however, despite a wealth of level crossing related research outputs, there is no structured process that can be used to apply human factors insight to the design of level crossings.

### Theoretical perspective

Understanding how and why people act and react at level crossings requires a distributed cognition approach, whereby information processing, and the resulting behaviour, is a product of the interaction between knowledge in a person's mind and information within the external environment. The Perceptual Cycle Model (PCM) is a framework from which to do this. It presents the view that human thought (schema) is closely coupled with a person's interaction (action) in the external environment (world), informing each other in a reciprocal, cyclical relationship. The PCM places emphasis on the processes involved in decision-making, as opposed to just considering the decision output. This is important for considering behaviour at level crossings in the context of local rationality, i.e. decision-makers act according to their understanding of the situation at the time, their conflicting goals and their 'normal' day-to-day processes, workarounds and adaptations. These considerations need to be captured within the design of systems that support real-world behaviours, rather than expecting people to behave in ways that designers may imagine them to.

## Data collection

The Schema World Action Research Method (SWARM, Plant & Stanton, 2016) provides a structured approach to obtain perceptual cycle data to capture how and why decisions are made. It consists of cognitive prompts to elicit perceptual cycle information against the three components of the PCM and associated sub-types within each one (e.g., schema is broken down into direct past experience, trained past experience, vicarious past experience and underdeveloped schema). Through an initial literature review and stakeholder workshop, the LX-SWARM was developed for the purpose of this research and was used to structure interviews with level crossing managers, signallers, safety specialists and engineers. A shortened version of the LX-SWARM enabled the capture of salient decision-making processes, and perceptions of safety, during observations of crossing users utilising different travel modes at a range of crossings (e.g., manually controlled barrier CCTV n=93, automatic half barrier n=21, and passive pedestrian/bridleway crossings n=12). In addition, a survey was disseminated on social media and sent to people who live near to level crossings. In parallel, to complete a holistic analysis, the PCM framework was used to review current level crossing risk management processes, mitigation measures and design activities.

## Preliminary findings

Data collection identified differences between how crossing users think a level crossing system is designed to behave and how it's actually been designed to work. For example, people violating manually controlled barrier CCTV crossings stated that *"…the barriers can be raised up again, we're being watched",* whereas in reality, a signaller's CCTV screen turns off when the 'crossing clear' signal has been given and the oncoming train has been cleared to approach the crossing. The PCM provides a common framework from which to understand the perspectives of different stakeholders and importantly to consider how these perspectives can be better aligned to one of compatible awareness (Salmon et al., 2013).

## Outcomes

When completed, the work will provide a detailed analysis of human behaviour at level crossings, which will be used to develop a set of tools and templates to help inform design interventions that will be beneficial to [industry partner], the wider rail industry and members of the public.

## References

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