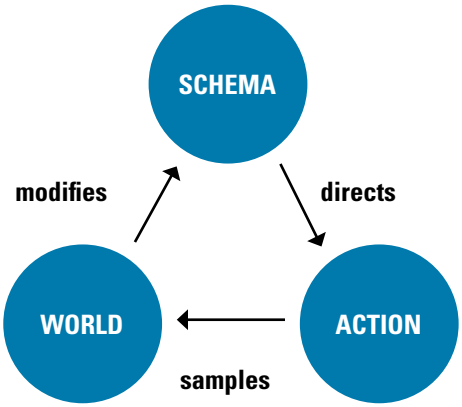
HUMAN PERFORMANCE IN THE SPOTLIGHT:

THE PERCEPTUAL CYCLE MODEL OF DECISION MAKING

In this series, human performance issues are addressed by leading researchers and practitioners in the field. **Katie Plant** gives some insights into the Perceptual Cycle Model as a framework to understand decision-making and automation surprise.

What is the Perceptual Cycle Model?

The Perceptual Cycle Model (PCM; Neisser, 1976) was originally conceived as a model to help understand how people process information. The PCM depicts a cyclical relationship between internal 'schema' (mental templates based on experiences and expectations) and information in the external environment. These schemas are triggered by situations and 1) lead to the anticipation of certain types of information, 2) direct our behaviour to sample or seek out specific information, and 3) provide a way to interpret that information. Our perception and experience of the environment can result in the modification and updating of our schemas, which in turn influences further interaction with the environment.



Why is it a useful framework to understand decision-making?

We cannot begin to understand work and safety without understanding the underlying processes that sit behind decision-making. In relation to failure situations, the term 'local rationality' accounts for why decisions and assessments made sense to the operator at the time they were made, given the context. The PCM can account for this process and facilitate our understanding of *why* a decision was made (rather than just looking at *what* decision was made) by embedding our understanding of decision-making in the wider context of the operating environment. The PCM is a useful framework for understanding why it made sense for an operator to do what they did, in light of the schema (past experiences and expectations that are used to rapidly categorise situations) and information in the wider environment (i.e., standard operating procedures, communications, technology, organisational culture) available to them at the time decisions were made. Importantly, the PCM emphasises the processes involved in decision-making, rather than the output. If a way of behaving made sense to one person, is it likely to make sense to another. Once we understand that, we are able to support operator decision-making. This might be through system design or decision aiding and training activities.

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Will different people have different perceptual cycles for the same situation?

In a nutshell, yes. It is argued that no two people will ever have precisely identical perceptual cycles because they will have different past experiences (schema) which are a key driver for decision-making. Even in an environment like air traffic management, where controllers are selected based on similar aptitudes and undertake the same training programmes, the precise nature of the schema that they hold will vary. This may be because they have internalised training in different ways or been exposed to something in an operational context which influences the expectations they now hold about a situation. Of course, work in safety-critical systems should be in accordance with standard operating procedures and regulations, but when things start to go wrong, people may revert to more automatic behaviours underpinned by their perceptual cycle.

How is the perceptual cycle framework relevant to automation surprises?

'Automation surprise' is an action performed by the automated system that was unexpected by the operator. On the flight deck, this is

often described as the pilot not fully understanding some aspects of the aircraft's automatic flight control system. If we think about this from the perspective of the PCM, then we need to understand the schemas that are held, the available information in the environment and the actions or decisions undertaken by an operator. The way in which an operator engages with an automated system will be influenced by the schemas that they hold for that system, i.e., what they expect to happen based on past experiences (which may include training, operational experience, or even vicarious experience from other people). This is coupled with information available to them in the world (e.g., what the system is telling them about status or mode). The occurrence of 'automation surprise' suggests a mismatch between the operator's schemas and the information in the world. Modelling an automation surprise event with the perceptual cycle framework would enable an understanding of what schemas were held by an operator, what information was available to them and how these interacted to result in automation surprise. Traditionally, operators have been blamed for not maintaining an accurate mental model or picture of automated systems, though arguably automated systems that cause surprise have not been designed or trained for in order to support the ways in which operators perceive information and make decisions.

How can people be supported to make 'better' decisions?

A central tenet of the PCM concerns the role of schemas in decision-making. Schemas are built through past experiences and are advantageous at reducing cognitive expenditure by directing attention and influencing action. They can, however, leave operators vulnerable to suboptimal decision-making if their schemas are inappropriate for an operational context. The perceptual cycle model can be used to enhance decision aiding and training. For example, operators can be trained in perceptual cycle processes to understand how internal schema and external information interact and influence decisions and actions. Operators can be trained on sources of potential bias from the schemas that they hold, which may result in suboptimal decisions. Critical incident training can encourage operators to reflect on assumptions they may bring into a situational assessment and critically evaluate the information they have available to them. This can help to avoid 'cognitive lockup' or tunnel vision. Similarly, interfaces and systems can be designed to support natural decision-making processes, by using the PCM for presenting information and designing interfaces that adapt to different situations.

Reference

Neisser, U. (1976). *Cognition and reality*. San Francisco, CA: W. H. Freeman and Company.

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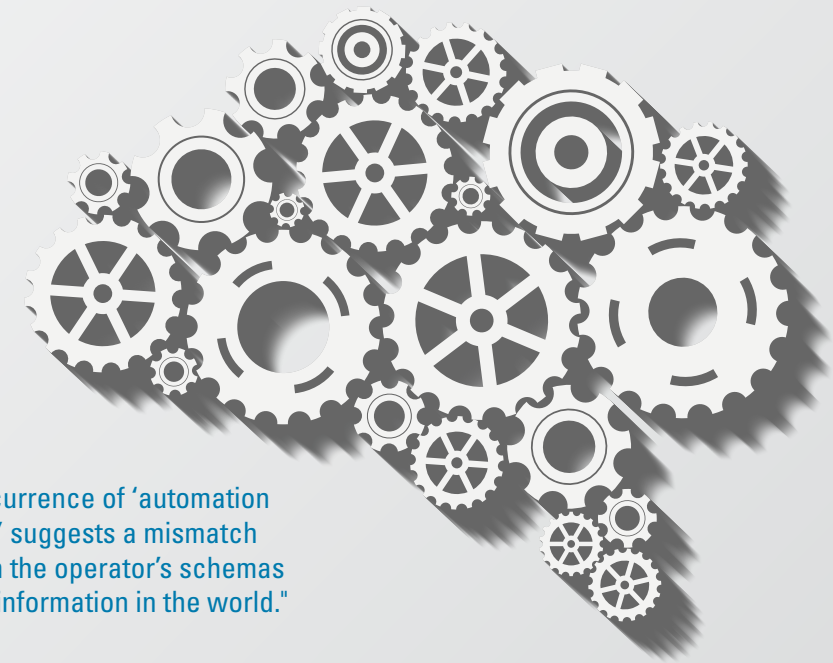

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