Einblicke in die Forschungsarbeit

RESEARCH PROJECT

Memories for future actions

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Future memory-guided behaviour

Daniela is a master's student in the Elite Graduate Program "Neuro-cognitive Psychology" at the Ludwig-Maximilians-University in Munich. As part of her master's programme, she worked on a research project in the Brain & Cognition Lab at the University of Oxford, examining how future action goals emerge alongside the encoding and retention of detailed visual information in working memory (WM).

Working memory guides adaptive behaviour

Imagine entering your bedroom after turning off the lights. In order to navigate to your bed, you use memorised visual information about where the closet, the nightstand and – of course – the bed is to guide your actions. This simple example highlights that memories are not only about the past, but also serve future behaviour.

Daniela Gresch and colleagues examined how representations of past sensations stored in WM guide our prospective actions. WM refers to the cognitive ability to store and manipulate recently acquired information for brief periods of time in order to guide adaptive behaviour. Despite the strong conceptual relation between WM and future actions, most studies have focused almost exclusively on how information is encoded or retained into WM rather than how the memorised information becomes utilised for action.

Action encoding for future memory-guided behaviour

Due to lack of understanding about the link between past sensations stored in WM and related future behaviour, Gresch and co-workers designed an electroencephalography (EEG) experiment taking a closer look at these memory-guided actions. EEG is a useful tool in cognitive neuroscience, as it provides researchers with a direct measure of neural activity with excellent temporal resolution.

A recently published study has shown that visual representations and their associated actions are concurrently retrieved from working memory (see 'Links'). However, it remained unclear when action plans become incorporated into WM. To this end, Gresch and colleagues tracked human brain activity related to action planning in a WM task. The results show that actions are integrated into WM at the time of visual encoding. This means that the brain does not wait for memories to become selected before considering the appropriate response, but instead integrates the action plan into memory from early on.

Interestingly, this early encoding of which action will be needed at the end of the trial was completely independent of the expected use of that action. That is, it did not matter if an action was needed early or late, the encoding period was statistically identically. However, following this encoding, participants showed gradual action preparation which depended on when these memories would become relevant. Moreover, Gresch and colleagues demonstrated that this early action encoding had consequences for future behaviour – stronger action encoding was associated with faster responses at the end of a trial.

To sum up, action encoding can bring significant benefits to cognition and behaviour: by bringing future actions into memory at an early stage, our brain creates a 'dual memory code' – containing action plans alongside visual representations – that renders memories more effective and more robust. In returning to the example at the beginning, Gresch and colleagues showed that before turning off the lights in your bedroom, you rapidly encode the necessary actions that will guide you to your bed.

More information on “Neuro-cognitive Psychology”:

- *https://www.psy.uni-muenchen.de/ncp/index.html*
- *https://www.nature.com/articles/s41593-018-0335-6*