Prof Paul N Wilson

Cognition research theme: ‘Cue competition in spatial learning’.

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Investigations of basic learning mechanisms in humans and other animals ask how we represent causal relationships (what leads to what), and how we find our way around in space (how we reach a goal). Traditionally, different learning mechanisms have been thought to operate during causal and spatial knowledge acquisition.

When we learn about causes, we often restrict consideration of all possible predictors of an event. For example, once we have established a likely cause of something we are particularly interested in, we are unlikely to consider newly added cues as potential causes of the same event, even when they occur at the same time. In contrast to this restricted processing of causal events, it has traditionally been assumed that there are no restrictions on learning about spatial cues. Once we have found our way to a goal using one set of landmarks we will continue to process all newly added spatial cues to ensure that our ‘cognitive map’ remains updated. That is, in contrast to causal learning, it has been proposed that spatial learning is not subject to restricted processing of added cues.

The current research programme suggests that, contrary to the traditional cognitive mapping view, once a goal has been located with respect to a particular set of spatial cues, processing newly added landmarks will be limited.

For example: Wilson and Alexander (2008) asked people to explore a virtual-environment, similar to a first-person 3D computer game (see a screen-shot from the experiment, below left). The walls of the virtual enclosure formed a distinctive shape (as illustrated in the plan, below right). The participant's task was to find an invisible platform, the location of which is illustrated as a white line in the screen shot, and a broken line on the plan diagram. Of course, during the exploration task participants could not see this goal, but they could find it because a loud bleep alerted them when they ‘moved’ onto it. With sufficient practice, participants learned to find the invisible platform quickly, based only on its location in relation to the shape of the walls. At this stage we added an upright cross inside the virtual enclosure (which can be seen near the centre of the screen-shot)
and asked people to continue to find the invisible platform for many more trials with the cross nearby. Subsequently we tested how much they had learned about the relationship between the cross and the invisible platform during these additional exploration trials. Learning about the cross proved to be very much poorer than predicted by the cognitive mapping theory. Acquiring knowledge about the spatial relationship between the walls and the goal blocked learning about the relationship between the cross and the goal.

Therefore, in contrast to predictions from a traditional view, our experiments have shown that similar restrictions on information processing occur when we learn about spatial as well as causal relationships. This outcome supports our view that similar mechanisms of knowledge acquisition underpin both kinds of mental activity.

**What implications are there for society?**

Studying the mechanisms that underpin spatial learning has a number of practical implications. I have investigated the potential for virtual environments to help physically disabled children to find their way around the real world. This is important because these children often have poor spatial awareness due to lack of independent exploration. These experimental procedures may provide useful diagnostic tools for cognitive impairments and dementias, such as Alzheimer’s Disease.

**What implications are there for other academics?**

Research councils invest considerable funding to investigate the brain structures that underpin spatial learning. It is essential to refine learning theories and establish measurable behavioural effects that reflect on them if these investigations are to be of maximal value.

**Publications**

