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The View Association Model of Embodiment Effects in Spatial Learning

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The View Association Model (VAM) is a novel account of how interacting with a spatial layout in different ways can lead to differing representation of the space. VAM provides an account of data demonstrating the learning of different spatial associations when the same layout is learnt through 3D Virtual navigation and 2D map navigation.

Embodied views of cognition suggest that representations of the environment can be understood by examining how they complement the perceptual-motor programs used to interact with the environment (Ballard et al., 1997). Inherent in this perspective is the suggestion that different environments will typically require different perceptual-motor programs that will in turn require different internal representations.

Miles & Howes (submitted) found that spatially close items became associated when participants learnt a space by navigating through it in a 3D Desktop Virtual Environment (DVE), but not when the space was a learnt by navigating a 2D map. The data presented by Miles & Howes suggest two questions. Firstly, what are the differences in the way the DVE and 2D map were learnt? Secondly, how do these differences lead to spatial association in the DVE condition, and its absence in the 2D Map condition? The View Association Model (VAM) attempts to explain these data and provide answers to both of these questions.

The View Association Model

VAM learns the locations of items in a space by learning the visual location of an item in a particular view of the space. A view is defined as a single static depiction of a space (or a portion of that space) from the viewer's perspective. In the plan view condition used by Miles & Howes participants only see a single view of the space. However in the DVE condition a large number of possible views of the environment are possible. A consequence of the views available in the DVE and 2D Map conditions is that different perceptual-motor programs are required for successful navigation.

Although, VAM moves around the DVE and Plan View in similar ways, the motor actions needed to facilitate movement are different. To move in the DVE VAM must point the direction of view toward the item it wishes to move to and press down the space bar. Subsequently VAM adjusts the direction of motion by moving the mouse. When VAM interacts with the 2D view a similar mode is adopted, but key presses are used to navigate. VAM presses a key to start moving in a desired direction and that key remains depressed until another key is preferred.

As VAM moves toward an item in both conditions a course correction algorithm is periodically engaged. VAM searches for the target item in the current view and then compares its current heading with the heading needed to get to the item. In the DVE it will then adjust the view so the target item is in the centre of the view (thus correcting the heading). When interacting with the 2D Map VAM will simply decide which key will move the red dot closest to the target item.

The algorithms used by VAM to move toward an item rely on bottom up processing to initiate course correction. The bottom up processing not only focuses attention on the target item but, by default, focuses attention periodically on other items that happen to appear in the current view. This occurs when VAM searches the current view for the target item, rejecting non-target items before it locates the target item. When attention is focused on these non-target items then there is a chance that VAM will elaborate the name of the item and an associative link will be formed between the item and the current goal item.

Crucially, only items that appear in view will be elaborated. Hence associative links will tend to form between items that appear in the same view. In Miles & Howes' 2D map condition all items are always in the same view. But in the DVE condition only subsets of items appear in any given view and typically items appearing in the same view will be proximal. Hence the interaction of the course correction algorithm and perceptual display lead VAM to predict the pattern of data observed by Miles & Howes.

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