The Role of Distal Cues in Human Spatial Navigation

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Navigation is a ubiquitous part of human life, and is extremely important in order to achieve goals, identify locations, find food, etc. People vary dramatically in the way they accomplish this critical activity. For example, they may use environmental landmarks as navigational beacons, resort to wandering, or stick to well-known paths. These differences in navigational style likely reflect the use of different kinds of information, representations and processes. Using a rodent model of learning mechanisms, we explore how different sources of information might be utilised by humans to learn and navigate novel environments.

Early navigational studies using rodents (Tolman, 1948; Restle, 1957) identified two major classes of navigational strategies using a simple T-maze. Rats approaching the same goal location in both training and test conditions were said to be using 'place learning', and rats who favoured the previously learned path under test conditions were said to use 'response learning'. Extending these findings to study human navigational strategies, Marchette, Bakker & Shelton (2011) designed a virtual environment and a task that could either be solved by taking a previously learned path (a more 'response'-based solution) or by taking a more direct shortcut connecting the starting point and the goal location (a more 'place'-based solution). The results showed that individuals varied in the degree to which they used the two types of solutions, with some overwhelmingly favouring the use of shortcuts, and others preferring to stick to the route. Most participants, however, used both types of solutions, indicating that many individuals acquired and employed both place and response learning as they interacted with the environment.

Given that many individuals do appear capable of both place and response learning, a key question regarding navigational style is identifying the factors that may push an individual towards using one solution over another. One such aspect that may effect changes in solution use is the availability of cues in the environment. Cues are typically classified as 'distal' (far away, or outside the environment) or 'proximal' (accessible, within the environment). Distal cues are thought to provide information about direction and orientation, as their position remains relatively constant no matter where the navigator is in the environment, whereas proximal cues provide more precise information about distance and choice points in the environment. From the rodent literature, we might expect that place learners use distal cues to orient themselves in the environment relative to the goal, enabling them to use shortcuts, whereas response learners might be more sensitive to proximal cues for initiating specific learned behaviours. However, our understanding of how these different cue types affect human navigation is currently quite limited.

In order to study the influence of cues on navigation, we modified the environment to include distal cues during the learning phase, as participants studied the environment. Subsequently, we made distal cues either present or absent as participants actively navigated. By examining their success rates, as well as the types of solutions used, we could measure the impact of distal cues on performance and how this varied across individuals who used different navigational strategies. In a series of behavioural experiments, we varied the number of distal cues in the environment and the degree to which they were either more 'continuous' or more 'discrete'. These results suggest that while humans may not be particularly sensitive to distal cues as they navigate through complex environments, this sensitivity may well depend on the information that these cues convey.