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Memory Systems Involved in Updating Multiple Object Locations

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Background

An ongoing debate in spatial cognition research concerns the memory systems involved in spatial updating. Some have argued that humans primarily keep track of objects in their environment by maintaining dynamically updated self-to-object spatial relations (e.g., Wang & Spelke, 2000). Others have argued that such egocentric updating is very limited and that in the absence of perceptual support, humans generally rely on enduring allocentric representations of object locations (e.g., Mou, McNamara, Valiquette & Rump, 2004).

One way to contrast these competing accounts is to look for changes in the internal consistency of pointing after certain manipulations (e.g., disorientation, various amounts of movement). Recently, Waller and Hodgson (2006) reported an abrupt increase in configuration error (which is an index of the internal consistency of pointing to different objects) from small rotation angles (0°, 45°, 90°) to larger ones (135°). They argued that this finding reflects a switch from a precise but transient representation to a less precise enduring one. Unfortunately, the authors did not test angles larger than 135°.

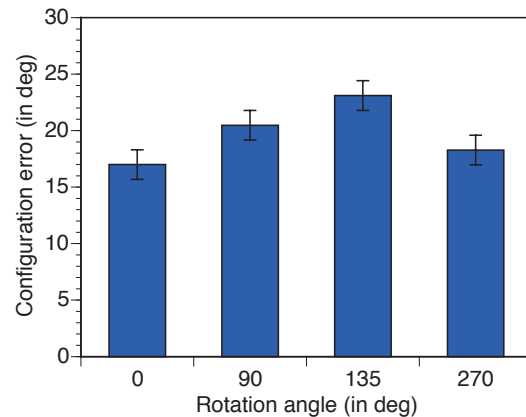
The goal of the present experiment was to overcome this limitation and to test three hypotheses on the memory systems underlying spatial updating:

- (1) transient egocentric – configuration error (CE) should be either unaffected by rotation angle (if updating is efficient) or it should gradually increase with increasing rotation angle
- (2) enduring allocentric – CE should be low for facing directions that are aligned with salient environmental features and therefore more likely to correspond to reference directions in the representation
- (3) switch from precise transient to less precise enduring – CE should be low up to a certain rotation angle and then increase abruptly

Method

24 participants studied layouts of six objects from the center of each layout, while facing a direction (0°) that was aligned with the walls of the surrounding rectangular room. For each of the four rotation conditions (0°, 90°, 135°, & 270°), participants turned the appropriate amount and then pointed to each object twice in randomized order while blindfolded. Every participant was tested on four layouts. Configuration error was the primary dependent variable.

Results & Discussion



Configuration error was lowest for 0° rotations, intermediate for 90° rotations and highest for 135° rotations, as reliance on a transient egocentric system would predict. Performance was, however, better on 270° than on 135°, which is incompatible with both the hypothesis of the primacy of a transient egocentric system and the hypothesis of a switch from an accurate but transient system to a less accurate but enduring system for large rotation angles.

The results are best described by reliance on allocentric representations, in which the study direction (0°) and, to some extent, the other directions aligned with the walls of the room (90°, 180°, & 270°) were selected as reference directions.

Acknowledgments

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