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Two spatial memories are not better than one: Evidence of exclusivity in memory for object location ☆

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Abstract

This paper studies the dynamics of attempting to access two spatial memories simultaneously and its implications for the accuracy of recall. Experiment 1 demonstrates in a range of conditions that two cues pointing to different experiences of the same object location produce little or no higher recall than that observed with a single cue. Experiment 2 confirms this finding in a within-subject design where both cues have previously elicited recall. Experiment 3 shows that these findings are only consistent with a model in which two representations of the same object location are mutually exclusive at both encoding and retrieval, and inconsistent with models that assume information from both representations is available. We propose that these representations quantify directionally specific judgments of location relative to specific anchor points in the stimulus; a format that precludes the parallel processing of like representations. Finally, we consider the apparent paradox of how such representations might contribute to the acquisition of spatial knowledge from multiple experiences of the same stimuli.

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1. Introduction

Imagine a row of shops with a bar at one end and a corner-shop at the other, and suppose that you stop twice outside these shops, at the same traffic junction, late on consecutive nights. On the first occasion, the bar lights are still on, as they are at the hotel some way down the row. All else is dark. On the second night, the hotel is once again fully lit but, of the rest, only the corner shop at the other end of the row has its lights on. Both views tell you something different about where the hotel is within the row of shops, and the question this paper addresses is this: Will our recall of the hotel's location be more accurate having both experiences to call upon? Are two spatial memories better than one?

The dynamics of how two traces interact at recall has recently become a topic of interest. In the recall of categorized word lists, Rohrer, Pashler, and Etchegaray (1998) suggest words from the same categories can be retrieved concurrently whereas those between categories must be recalled serially; implying that two recall processes from different categories are mutually exclusive. Maylor, Chater, and Jones (2001) come to the same conclusion using similar techniques with semantic and autobiographical stimuli. In a study closer to the present issues of interest, Brockmole and Wang (2002) also suggest an exclusivity of recall when recalling different representations of the same spatial environment. However, we note that other recent studies have provided evidence of parallel processing in concurrent retrieval processes (Logan & Delheimer, 2001; Logan & Schulkind, 2000).

Whereas these studies exclusively used response timings as the principal dependent variable, the experiments reported here investigate the *accuracy* of spatial representations when one or two memories are available to inform recall. Operationally speaking, the experimental approach is straightforward. Taking the example above, we can call the first experience of the hotel's location stimulus *J*, and test memory for the location of the hotel by giving the bar as a cue and asking how far along the row of shops the hotel was from it. Equally, we can test memory for the second sighting of the hotel (stimulus *K*) by giving the corner shop as a cue and asking the same question. Finally, we can test for both representations concurrently by providing both cues together. In all three cases, we measure how close the participant's recall of the hotel location is to the correct location as a function of the cue or cues provided.

We adopt this approach for three reasons. First, as we describe in the following paragraph, there are interesting theoretical alternatives with which to model accuracy and the dynamics of trace combination. Second, recent developments (described below) in the analytical modeling of location memory make these alternative mechanisms empirically discriminable. Finally, and possibly because of, the lack of suitable analytic methods hitherto, the accuracy with which location memory varies as a function of multiple experiences has been little studied. This is an issue where timeliness, a richness of theoretical opportunity, and the ability to discriminate between different theoretical positions, converge.

Considering accuracy of recall, we identify three main theoretical positions with which to describe the interaction and possible combination of two memory traces. First, the representations may be *exclusive*, such that only one representation can be activated or processed at any one time. Second, they may function *independently*, with the possibility that both traces may be activated to produce levels of recall higher than observed from