Spatial Priming of Recognition in Virtual Space

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Introduction

Virtual environments are often not veridical facsimiles of reality. Efficiencies of navigation are often made available to users with the use of hyperlinks but other schemes that violate the normal rules of Euclidean space are also possible (Ruddle, Howes, Payne & Jones, 2000). A virtual environment user may experience hundreds of different locations all with the same apparent Euclidean co-ordinates if space is allowed to overlap itself. It is anticipated that methods for probing subjects spatial representation that involve strategic processes (such as distance estimation and map drawing) will be poor for evaluating how subjects represent the discontinuities and spatial overlaps that occur in this kind of space. In most cases the unusual features of the space will be highly salient and are likely to input into any strategic process, distorting evidence about the representation of spatial information. An important advantage of a priming methodology in this case is the absence of any strategic processes – priming data are claimed to derive directly from the underlying representation of a stimuli. One aim of our current work is to establish the validity of priming methodologies for revealing human representation of virtual environments. We hope to achieve this by replicating work done using 2D map representations.

McNamara, Halpin & Hardy (1992) used priming in item recognition and location judgement to assess the relative contributions of order of presentation (temporal proximity) and spatial proximity on their participants representation of a two dimensional map. The experiment summarised in this paper used a similar design, however, instead of using a two dimensional map with object locations represented as dots we use a 3-dimensional virtual environment with object locations represented by small virtual cubes.

Experiment

Thirty-two participants navigated an experimental environment. Participants used the mouse to control where they looked in the 3D environment and the space bar to 'walk' through the environment in the direction faced. The experimental environment consisted of a large 'warehouse-like' triangular room, in which twelve items were located, and an antechamber from where subjects began. Subjects completed a training phase in which they were shown the location of the twelve items and then completed a test phase during which they had to indicate the correct location of each item. Training and test phases were iterated until the subject had successfully remembered the location of all the items. The twelve items were divided into four filler items, and four sets of pairs. Each pair was assigned to one of the experimental conditions (a 2x2 design with spatial: close-distant, and temporal: close-distant).

After the experiment, subjects were given recognition and then location judgement tasks. Immediately following a warm-up task the subjects were told that in the next section they had to decide whether the named items were included in the 3D environment they had learned. The twelve items from the 3D environment and twelve foils made up the list of item names presented. The paired items were presented consecutively, with one item, in each pair, acting as a prime and one acting as the target. These 24 item names were presented three times in the same order.

Results and discussion

A repeated measures ANOVA on the recognition response time data found a main effect of spatial proximity, $F(1, 31) = 4.62$, $MSE = 6980$, $p < .05$, no effect of temporal proximity, $F(1, 31) = 2.00$, and no interaction of spatial and temporal proximity, $F(1, 31) = .309$.

We are using these results to inform the building of computational models that learns the locations of the objects in the virtual environment. Spatial priming at close spatial and temporal proximity can be explained by a model that encodes each item's heading from the antechamber and any errors that are made whilst trying to find that item. However, to account for the main effect of spatial proximity a model using either metric or propositional information about relative object locations is required.

References

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