Planning a route with multiple targets in a regionalized environment

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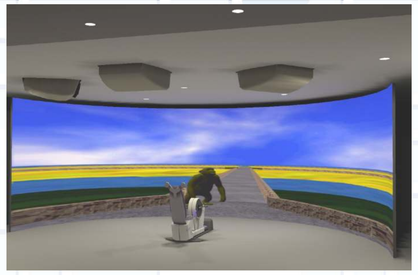
#1 Introduction

Environments that are divided into regions lead to hierarchical encoding of space. Such memory structures not only distort distance- and directional judgements, spatial priming and memory recall [1,2,3], but do also influence human route planning and navigation [4,5]. In this experiment we studied the influence of regions and clustered targets on the planning and navigation of complex multi-goal routes.

#2 Material & Methods



The setup:
Subjects were seated in front of a big half-cylindric projection screen and navigated through a virtual environment.

The experimental procedure:
Subjects went through an exploration phase (10 min) and a training phase before entering the test-phase.

#3 Prior Findings & Motivation

Prior Findings:
In prior experiments we have shown that:

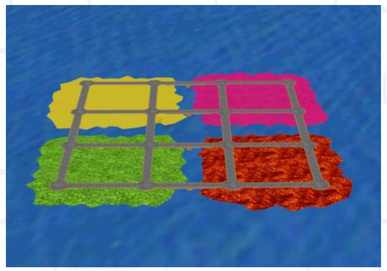
- subjects plan routes so that they minimize the number of region boundaries they have to cross [4].
- subjects plan routes so that they enter the region containing the target sooner rather than later [5].

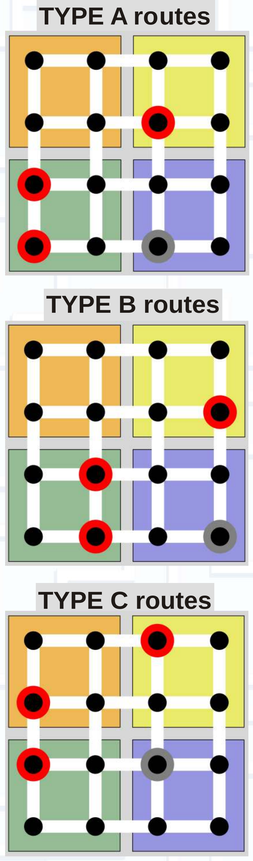
We suggest a *fine to coarse* planning mechanism that uses fine space information for the current location and coarse space information (regions) for the gaol.

Motivation:
This experiment investigated the impact of regions and target clusters on the order in which targets are visited on multi-stop routes.
Experiments with apes and monkeys [6,7] suggest that clustered targets are visited first.

#4 The Experiment

The Environment
Displayed *to the right* is a birds eye view of the virtual environment. Four islands (regions) contained four places each. The places were interconnected by roads and bridges and could be identified by unique pop up landmarks.



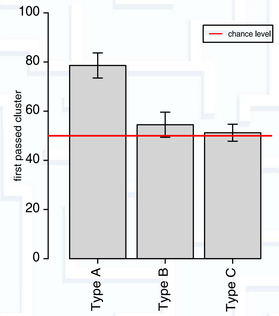


The Test Routes
During test phase subjects were asked to navigate the shortest possible (optimal) route connecting a start place (grey circle) and three target places (red circles). Route types (A,B,C) did not differ in the spatial configuration of start- and target-places but in the overall position. All route types had two neighbouring (clustered) targets and a sole target.

Type A: cluster region close
Type B: goal regions equidistant
Type C: no cluster regions

Variable of Interest
We evaluated subjects preferences to first pass the clustered targets as compared to the sole target. Both these alternatives allow for optimal solutions. Only error-free trials were included in the evaluation.

#5 Results



While subjects preferred to first pass the spatially clustered targets in routes of **Type A** (t-test against chance level (50%): t(19)=5.6, p<.0001), they performed at chance level in routes of Type B and C.

#6 Conclusions

Although the sole- and the clustered targets were equidistant from the starting place, subjects first visited the clustered targets in Type A routes.

- Subjects visited closest goal region first.
  - This result is consistent with the fine to coarse planning hypothesis (see #3)
- The order in which targets were passed by during navigation is independent of spatially clustered targets (see results for Type B and C routes).
  - This contrasts results from work with apes and monkeys [6,7].

#7 References

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