

Use of Vector- and Transition-based Strategies is Modulated by Knowledge of the Environment in Human Spatial Planning

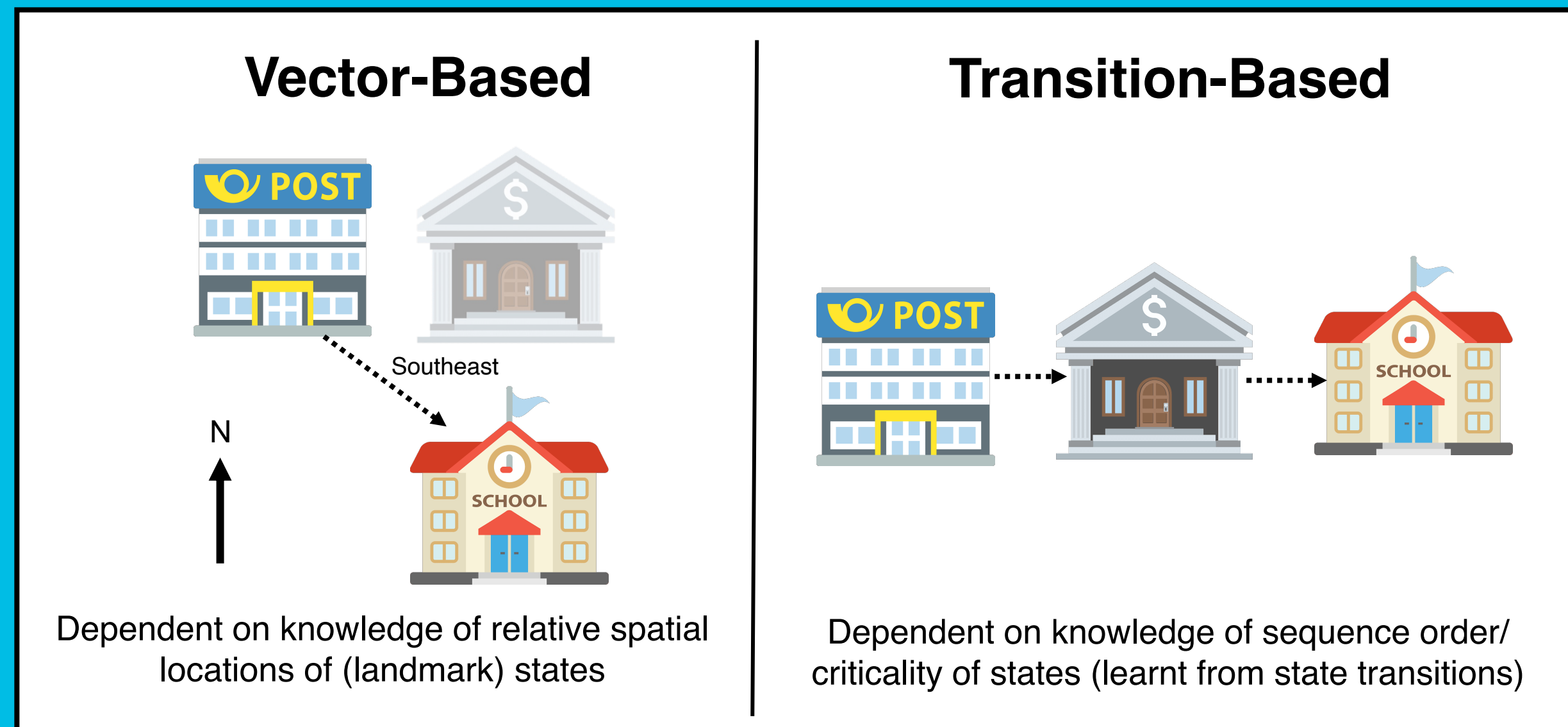
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Introduction

- Two ideas about how cognitive maps are used for planning:



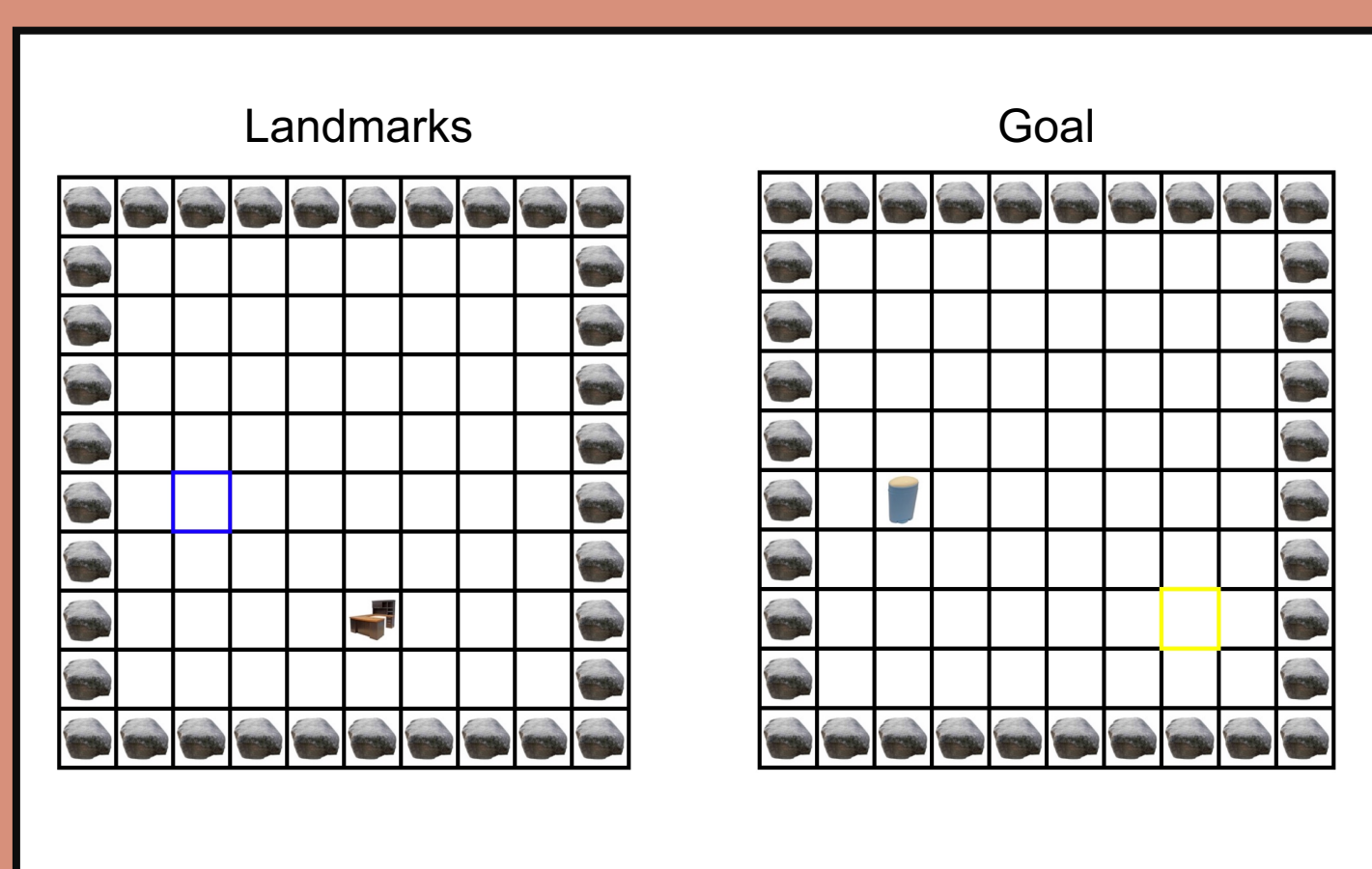
- How do we combine the two strategies?

- Knowing more states allow more accurate (transition-based) navigation, but implausible to know all
- Idea: Use vector-based strategies to head in general goal direction, fine-tune using transition-based strategies at well-learned states

Task Design

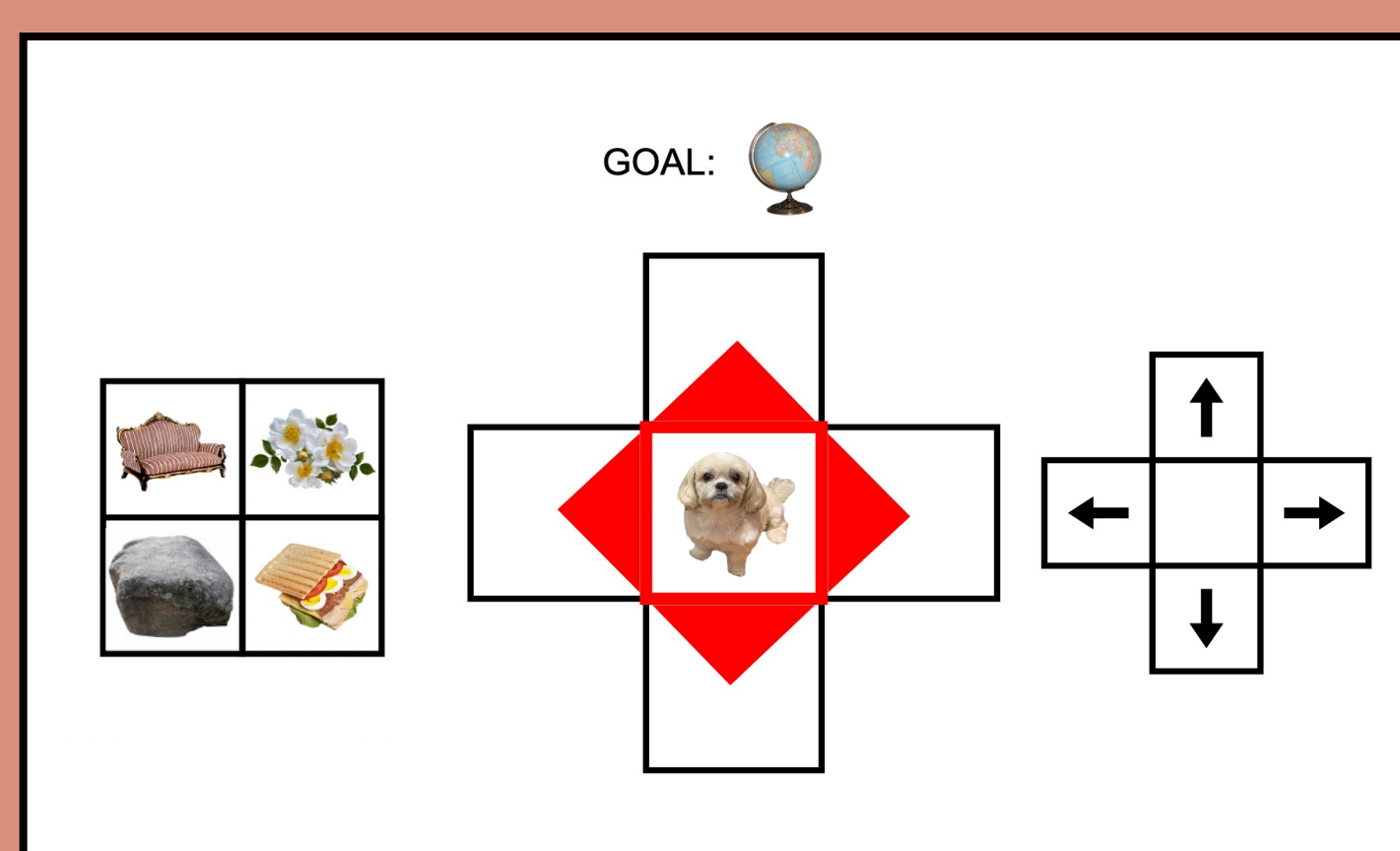
- Question:** does use of strategy depend on knowledge of states?
- Participants performed an online experiment in which they navigated through an 8x8 grid of 'objects'
- 4 blocks x 6 trials, each trial consists of 2 phases:

1. Learning Phase: manipulate knowledge of states



- Click on blue squares to reveal 'landmarks'
 - 16 clicks total
 - 2, 4, 8, or 16 landmarks
- Click on yellow square to reveal 'goal'

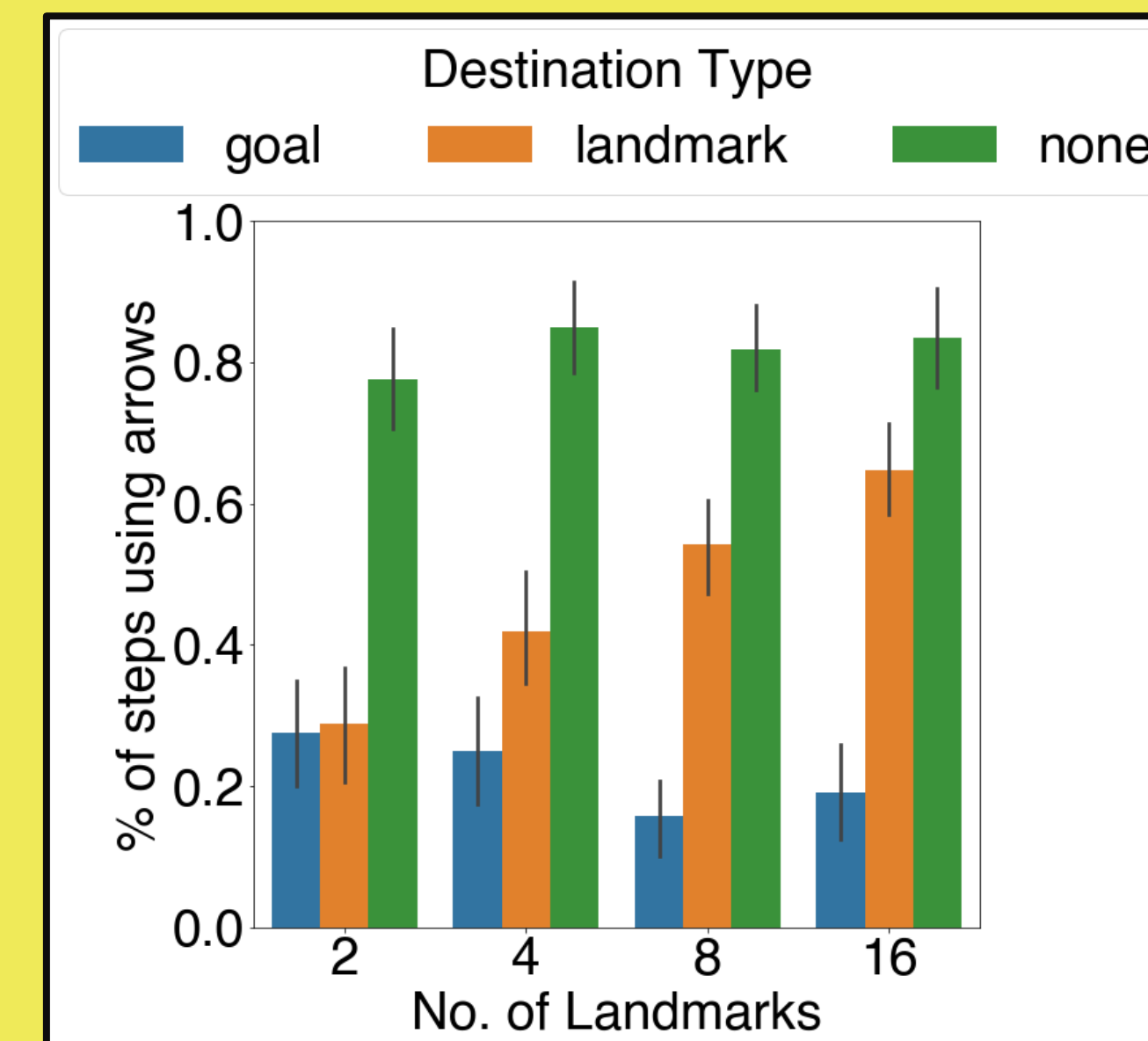
2. Navigation Phase: assess use of navigation strategies



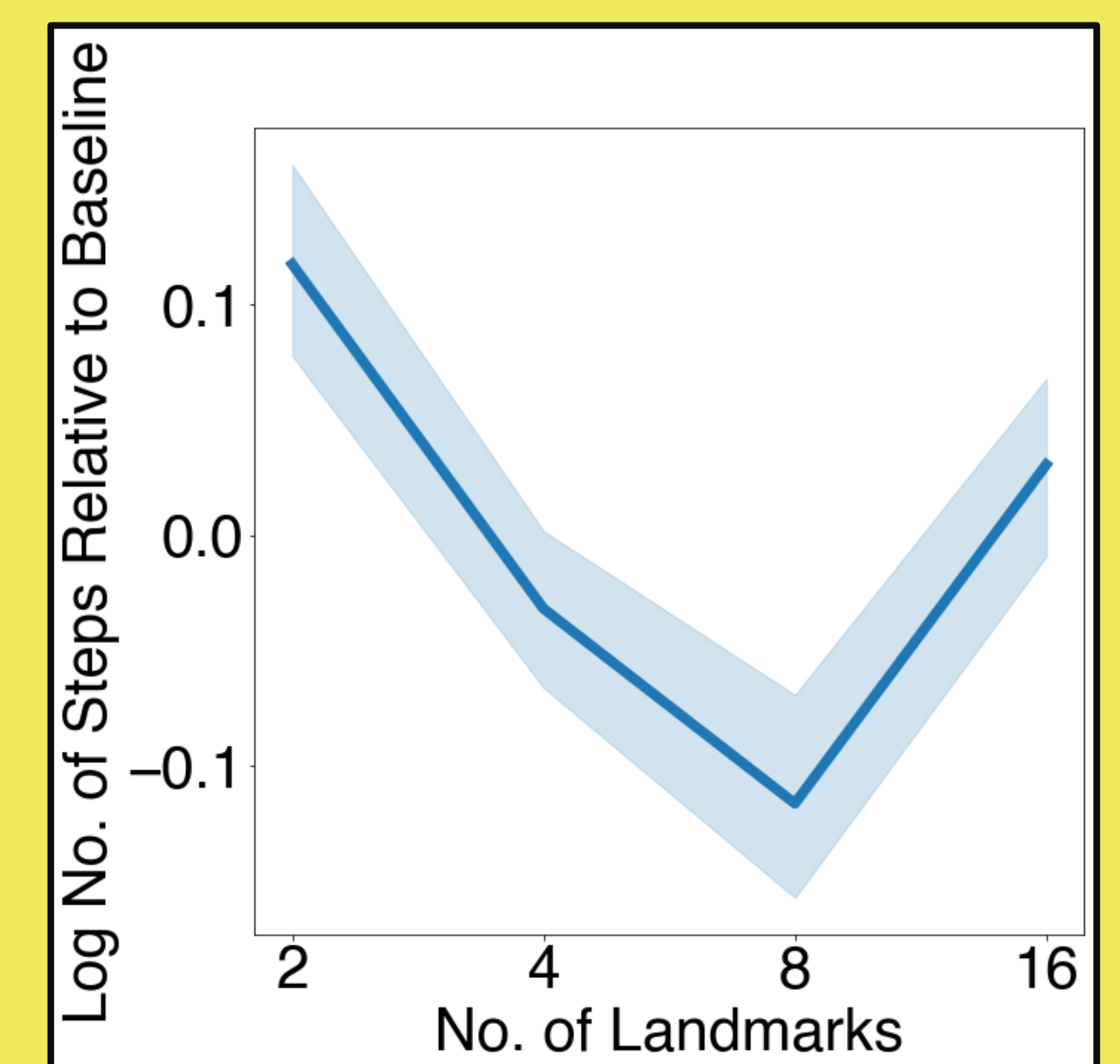
- Start in unknown location
- Navigate to goal in two ways
 - 'Vector'** – click arrow to move one step in direction
 - 'Transition'** – click object to move to that state

Both movement methods allow movement only to **adjacent states** (i.e., they are equivalent but allow dissociation of strategies)

Human Behaviour



Participants use 'transitions' more at well-learned 'landmarks'

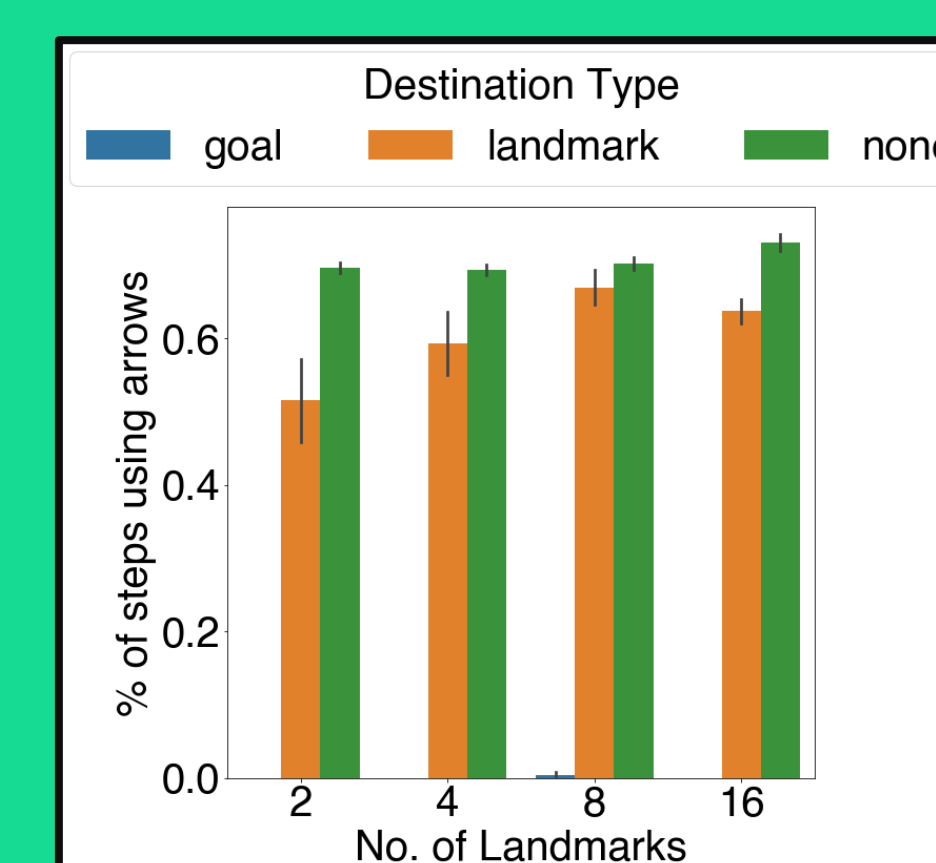


Participants perform best at an intermediate number of landmarks

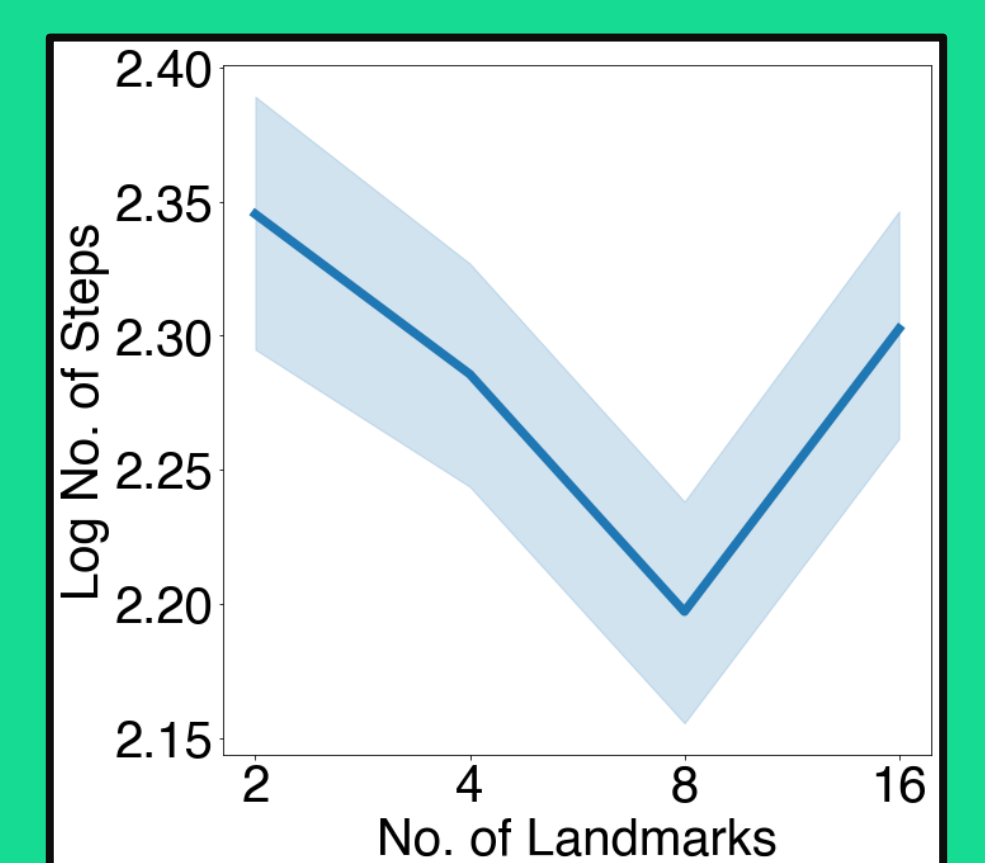
Trade-off between **familiarity** and **environmental coverage**

Computational Model

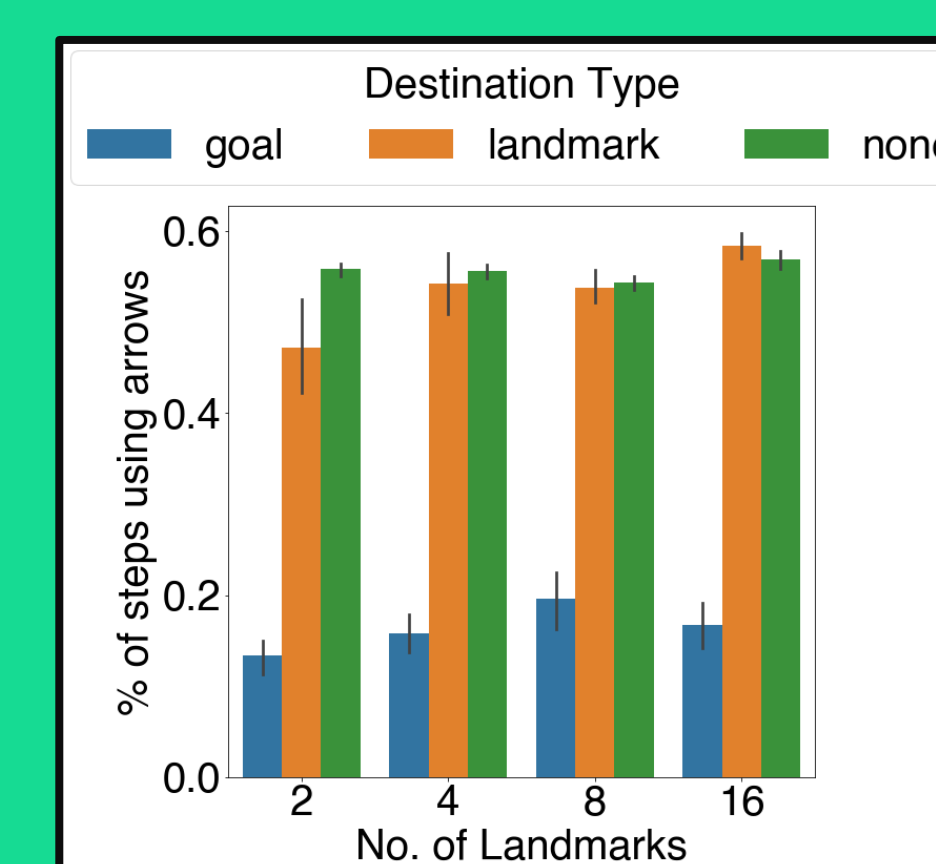
- MLP** trained to predict x/y-coordinates of landmarks
- Training iterations kept the same for all numbers of landmarks
- Agent chooses actions based on **estimated coordinates** and **uncertainty** (estimated by sampling MLP)



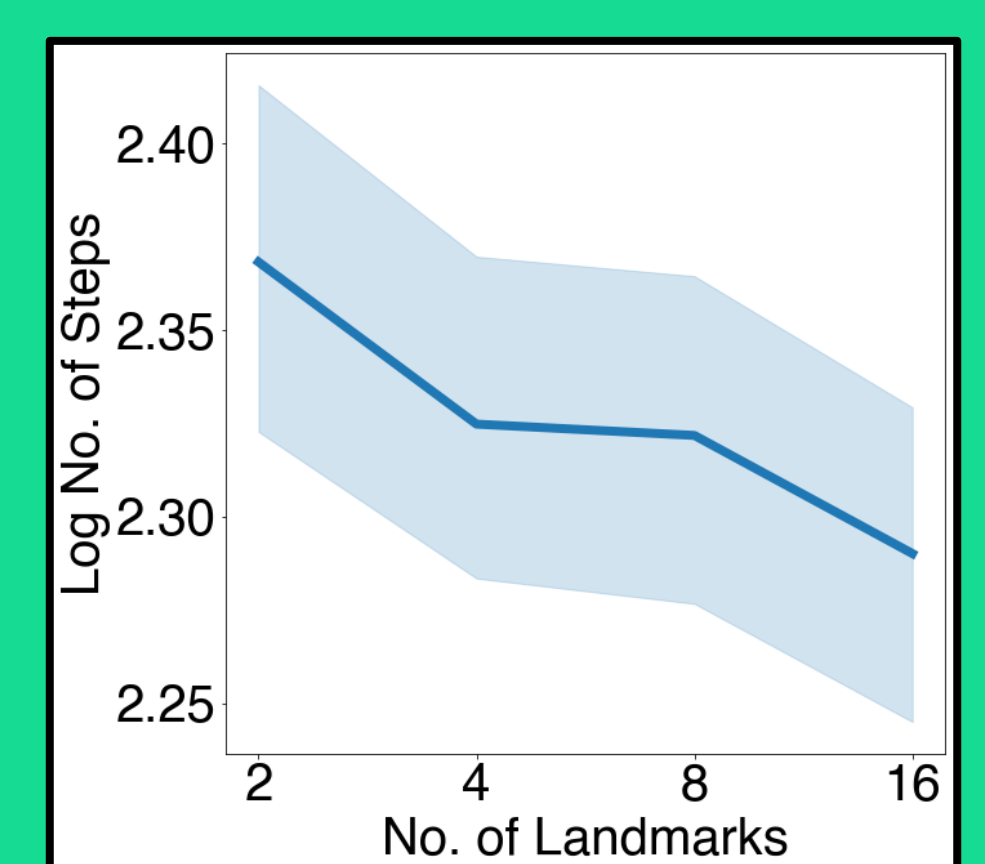
Model also uses transitions more at 'landmarks'



Model performs best at intermediate number of 'landmarks'



Model **without confidence-weighting** does not use transitions at landmarks



Model **with more hidden units** does not exhibit U-shaped pattern

Conclusions

- Participants flexibly use transition-based strategies near well-learned 'landmarks'
- Participants perform best at intermediate number of landmarks, likely due to memory constraints
- Paradigm for understanding use of transition- vs-vector-based strategies



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