Searching for hidden objects in 3D environments

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- Visual search in *natural scenes*

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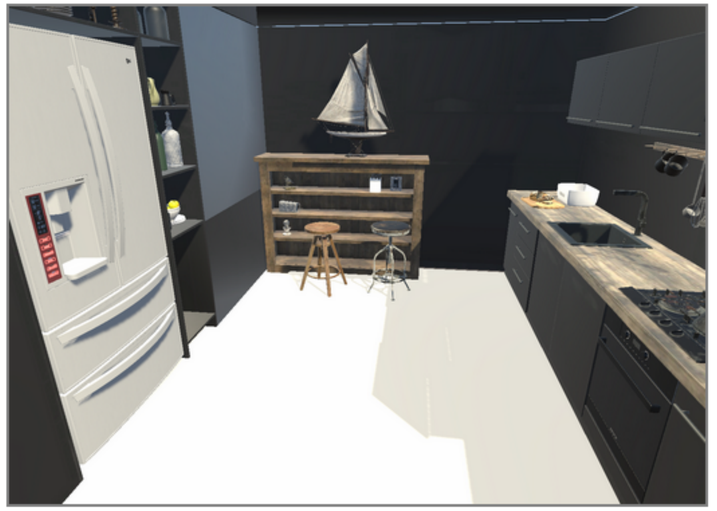
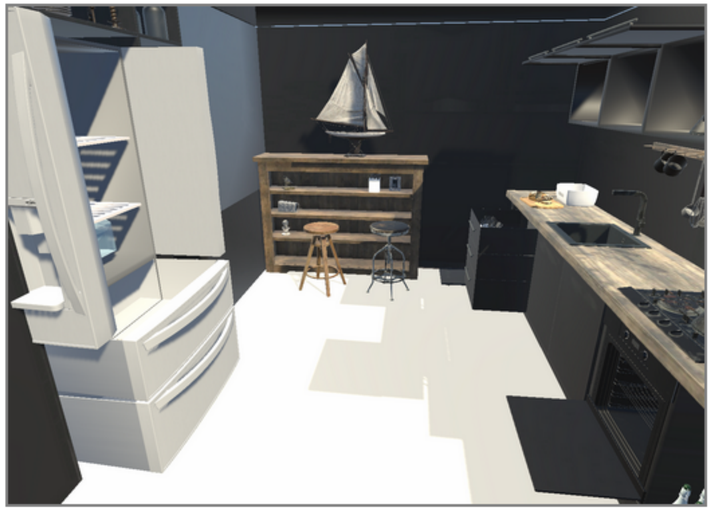


What makes it *natural*?

1. Quality of the stimuli
2. Freedom to move in the environment
3. Possibility to interact with the environment

In real life objects are not always neatly placed in plain view.

- Visual search in *natural scenes*



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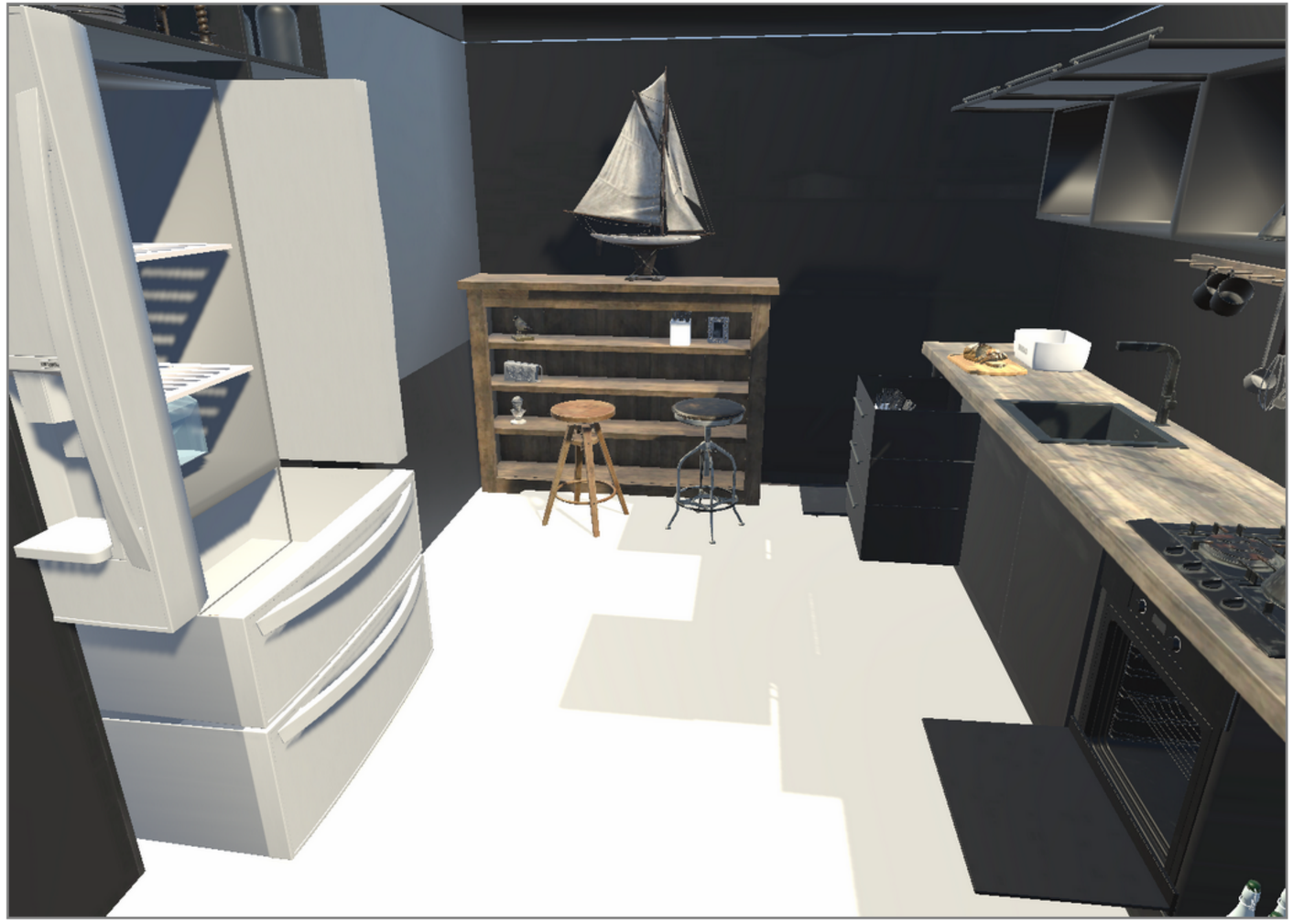


- Visual search in *natural scenes*

Very few studies entertained the idea that objects may be stored away.

I.e., hidden, but for logical reasons.

e.g., *Why are the batteries in the microwave?* (Rehrig, Cheng, McMahan & Shome, 2021)

- Visual search in *natural scenes*

We implemented:

- an object search protocol
- in complex 3D-modelled indoor scenes
- in virtual reality

- Visual search in *natural scenes*

We measured:

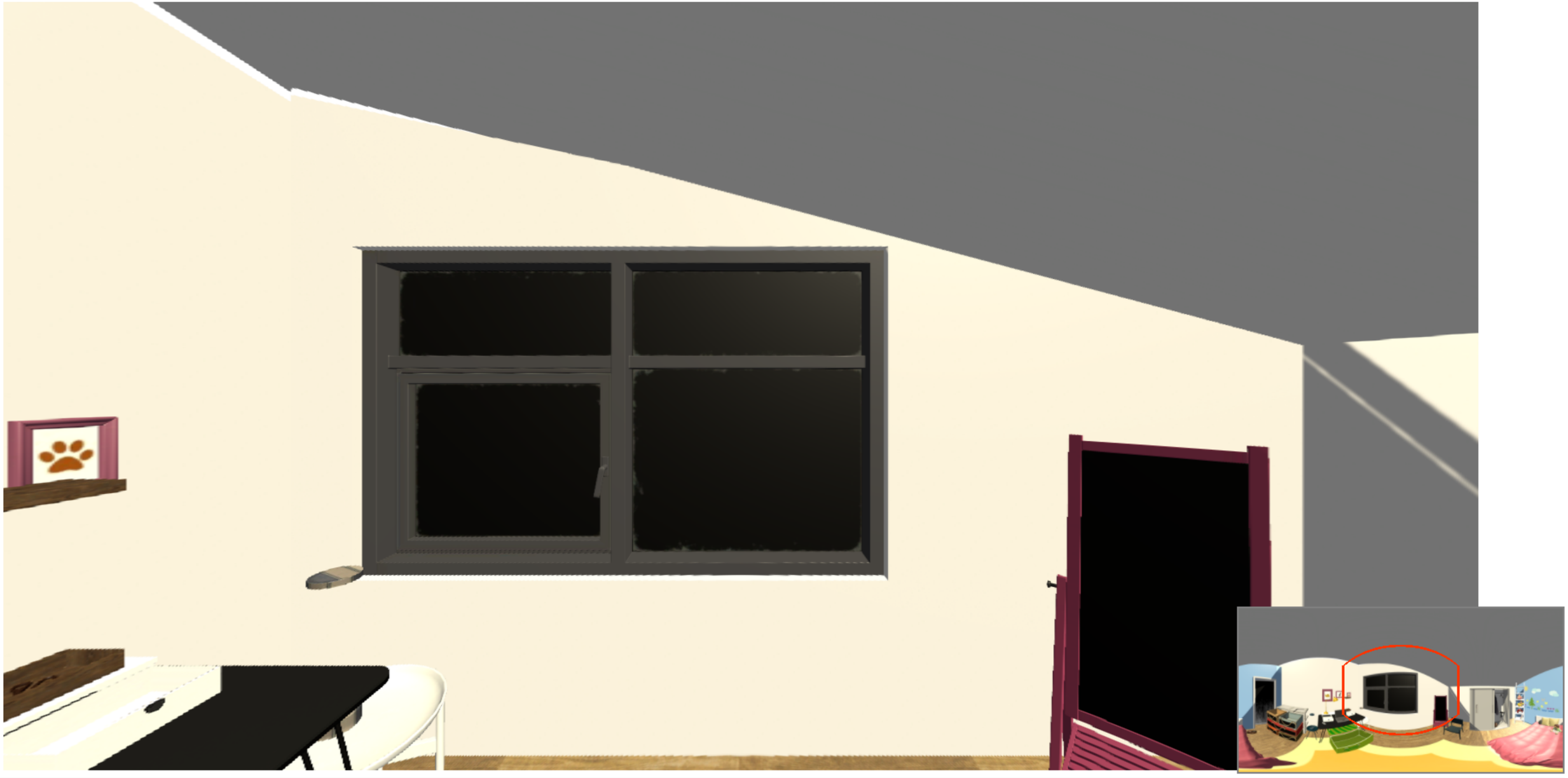
- Search behaviour (e.g., search time)
- Gaze (e.g., saccade amplitudes)
- Interactions (e.g., time to first interaction)

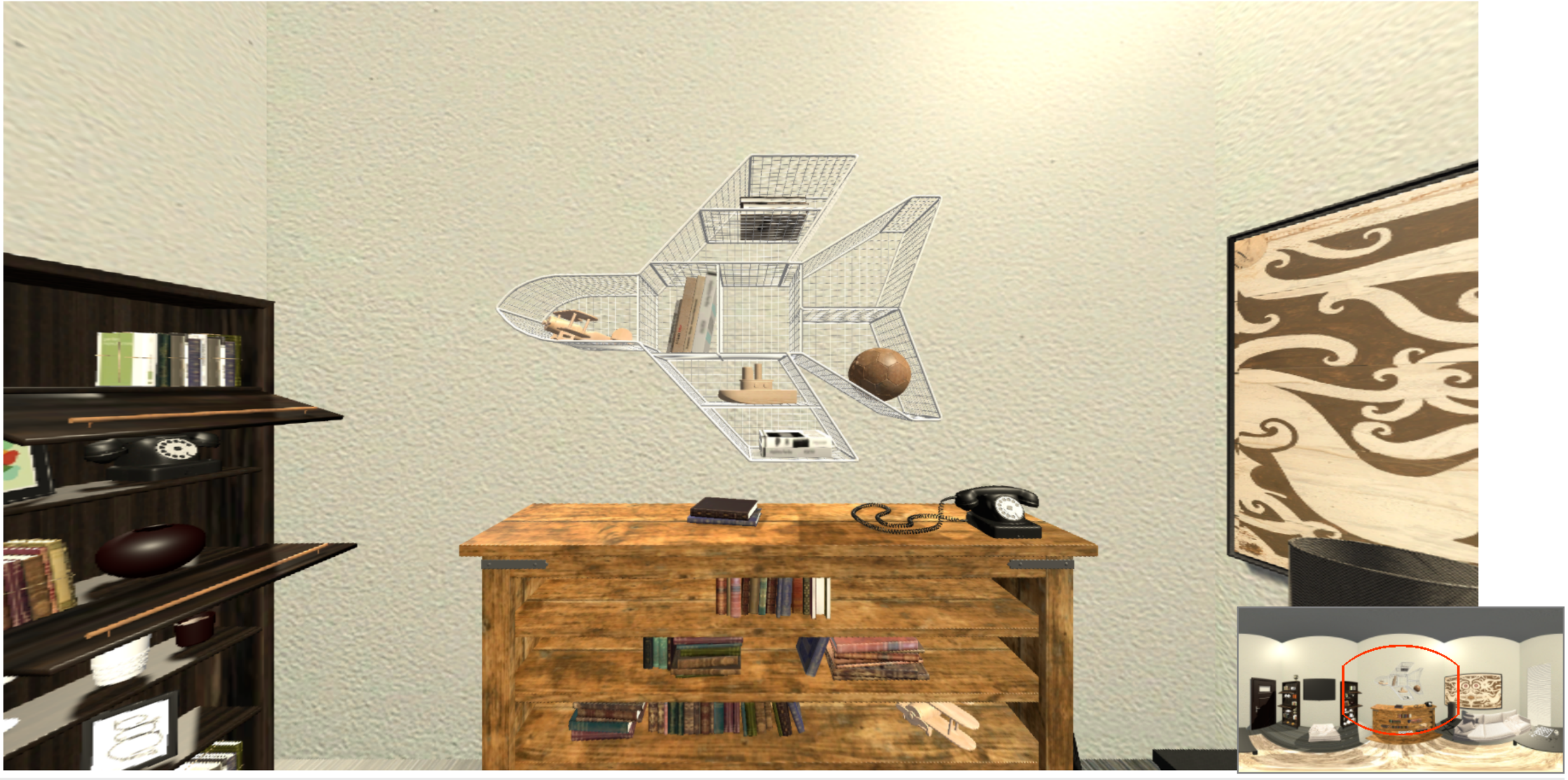
- Visual search in *natural scenes*

Strategy shift — knowing that you can interact with scenes would make you change search strategies

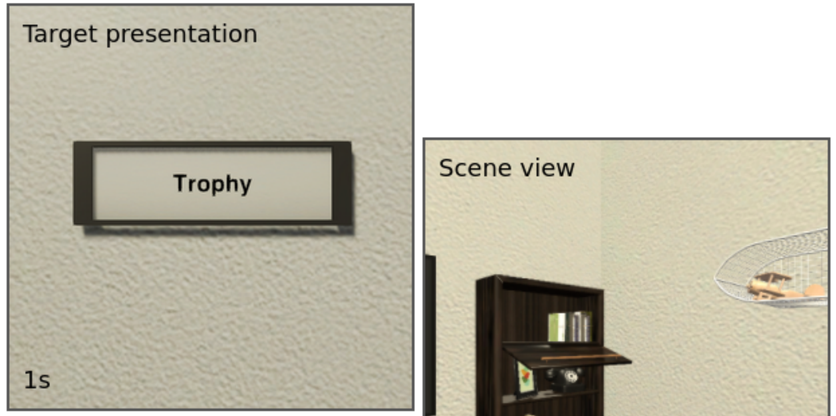
Hypotheses — When objects may be hidden, participants will

- take longer to find targets that are in plain view
- make shorter fixations and longer saccades to explore faster in general
- always interact with the scene





- Trial sequence



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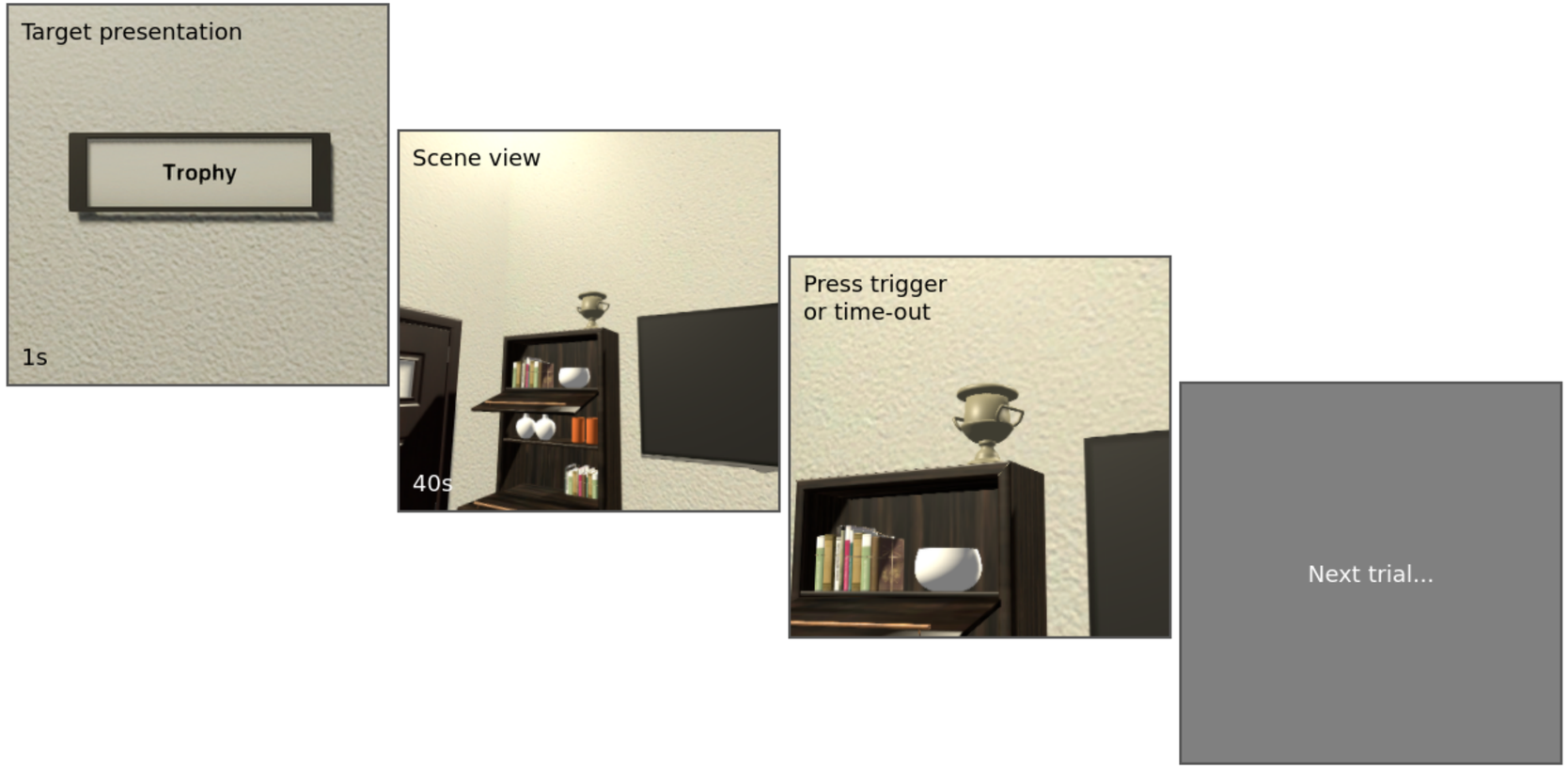
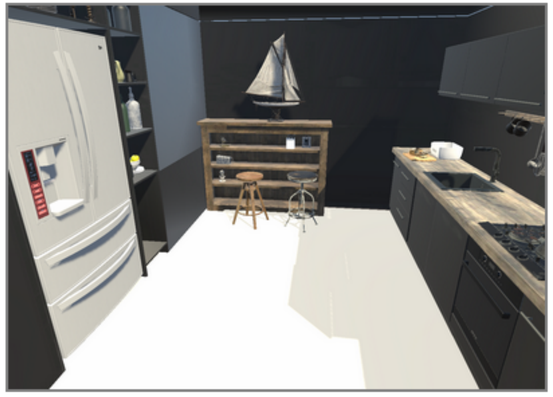
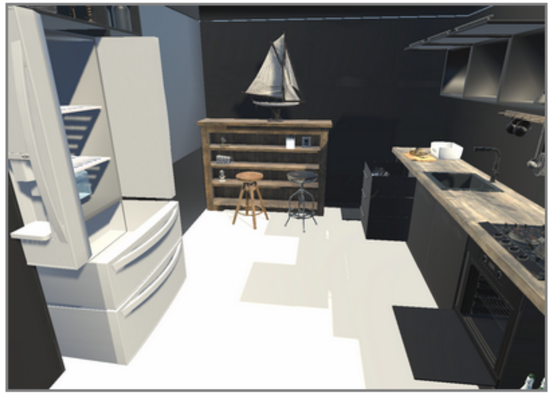


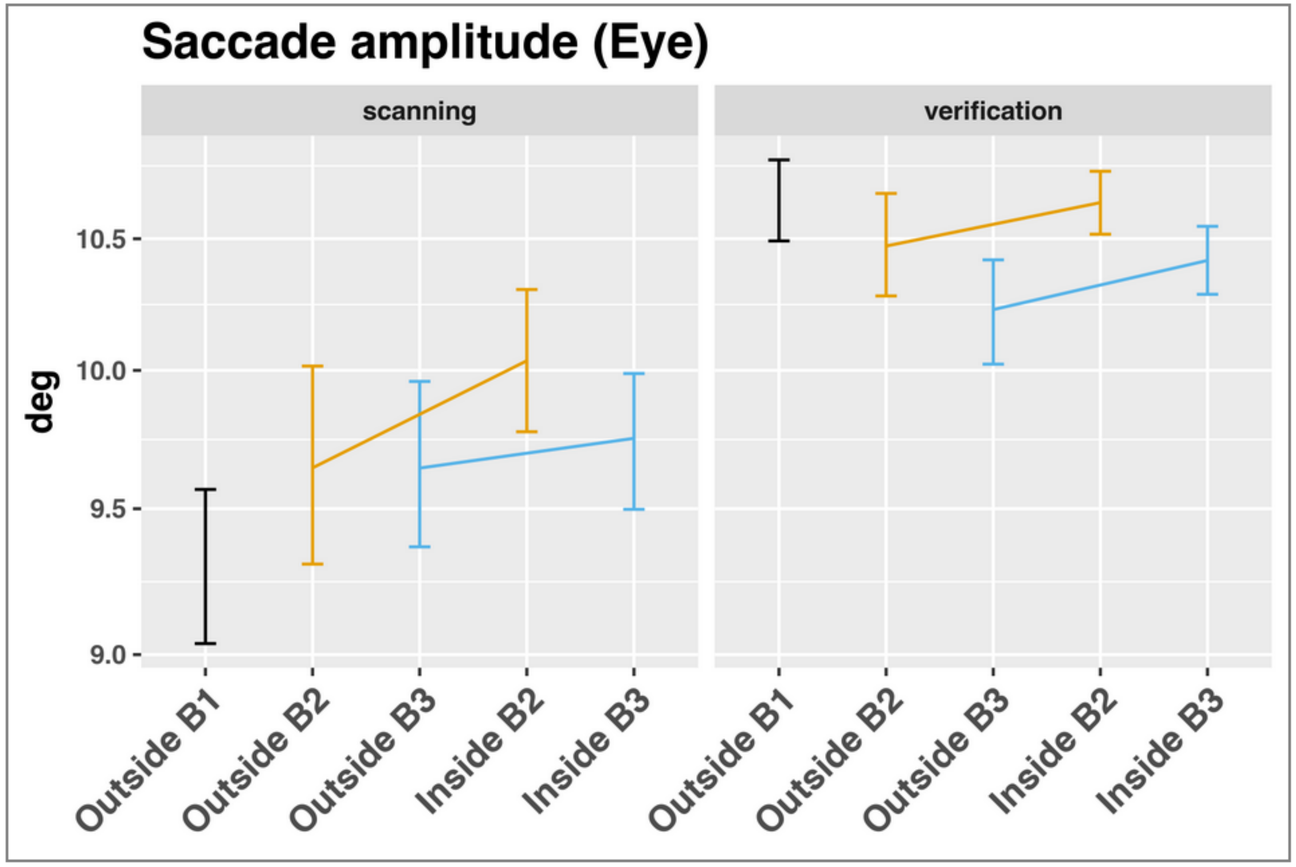
- Experimental design: blocks





Targets: always outside		**Targets**: 50% outside/inside		
Training	Block 1	Training	Block 2	Block 3
3 trials	27 trials	3 trials	24 trials	27 trials

- Results — Gaze data



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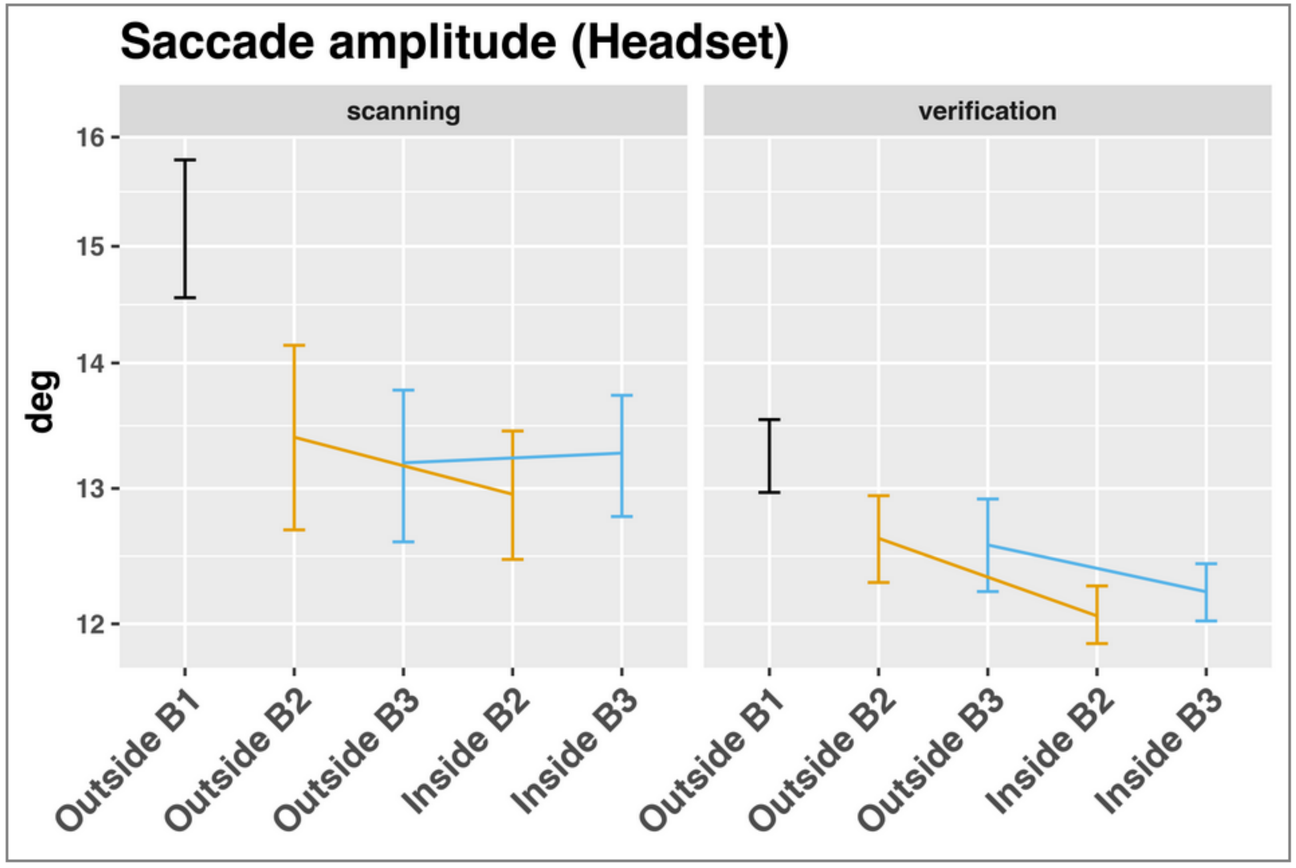

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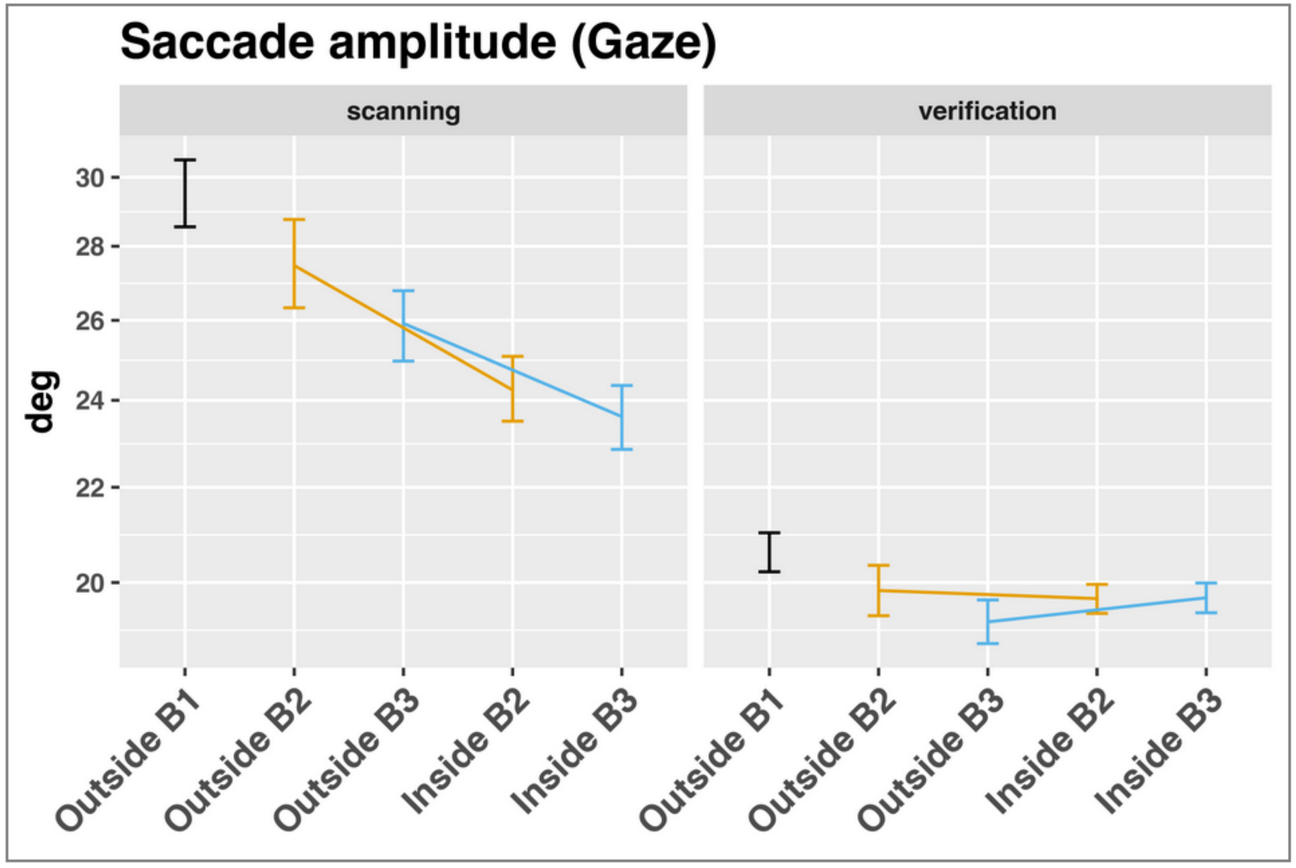

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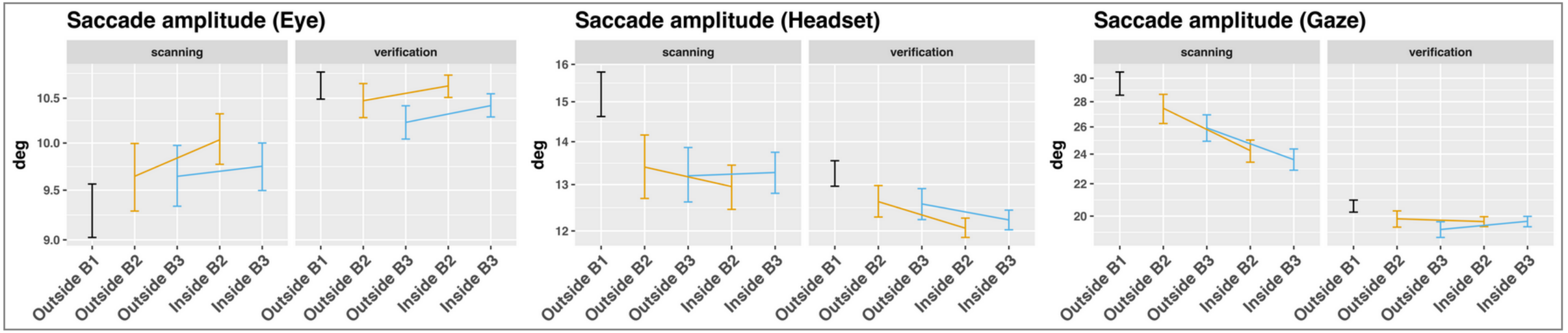
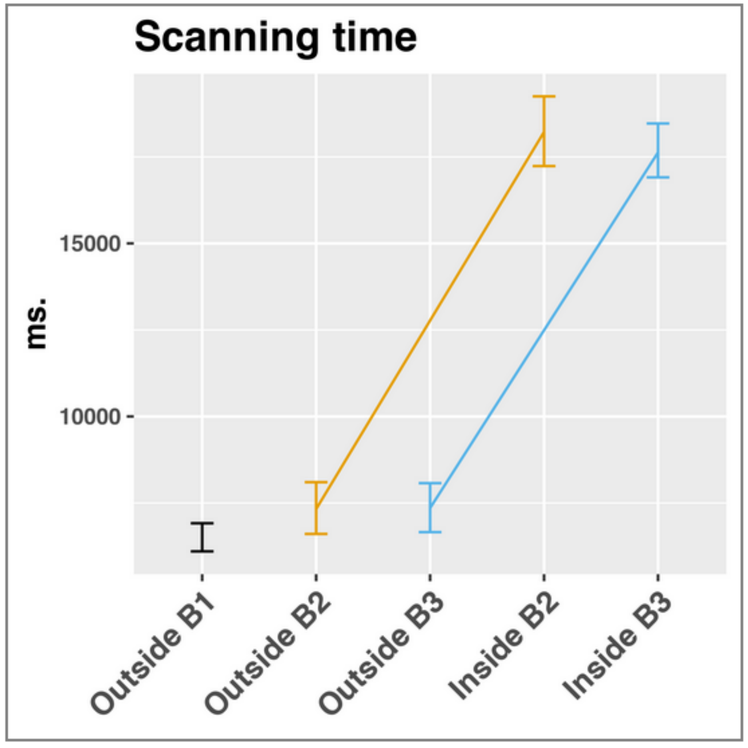
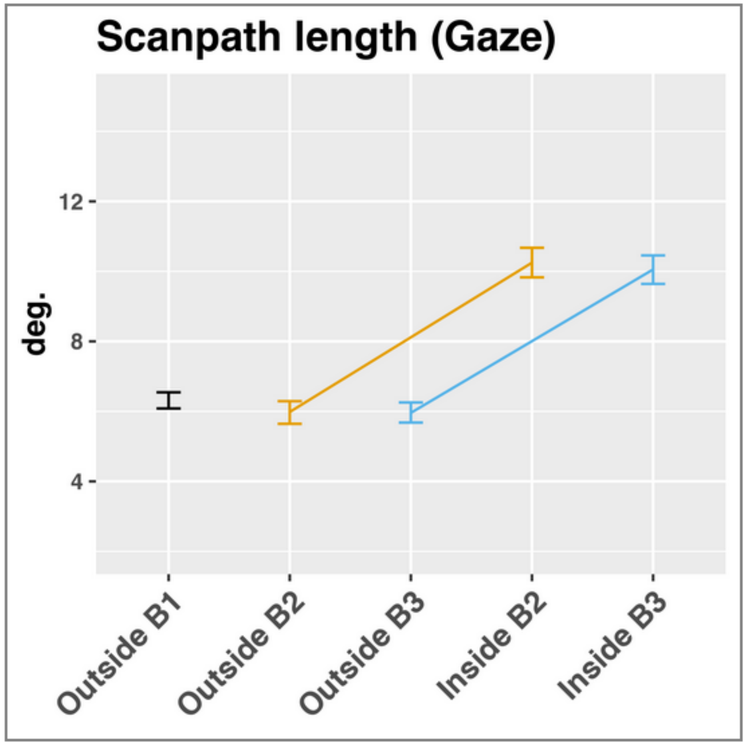


- Stabilise head to focus on a container
- Eyes scan the content

- Results — Search behaviour





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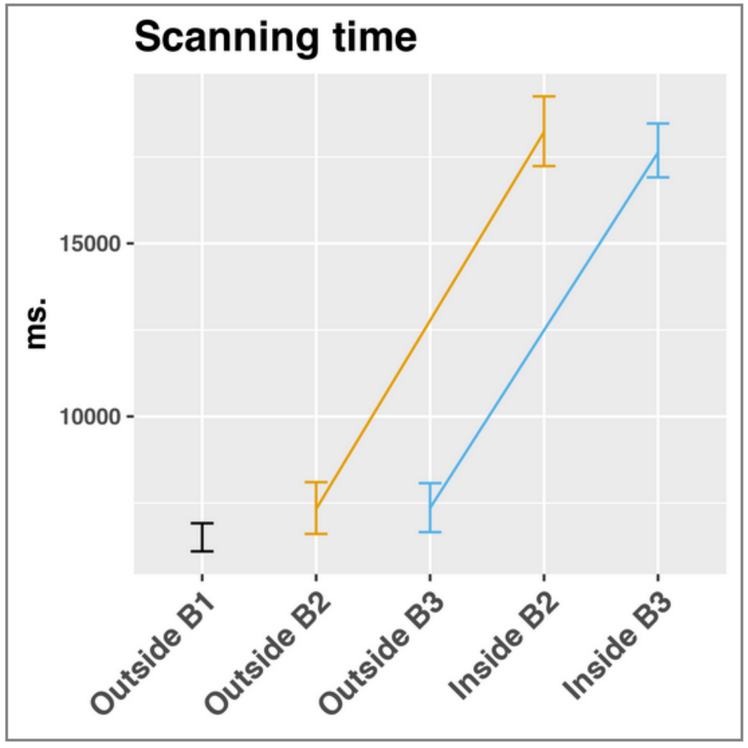
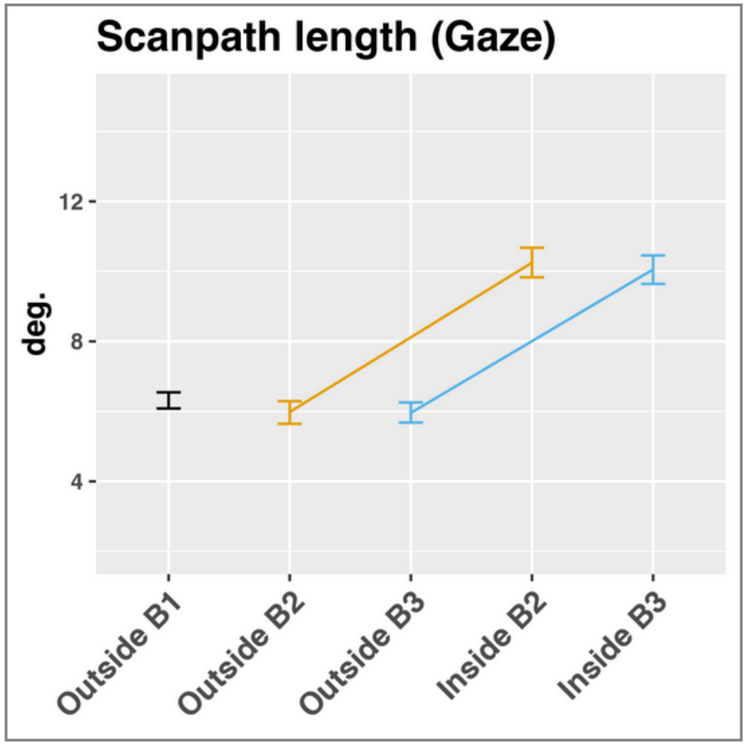
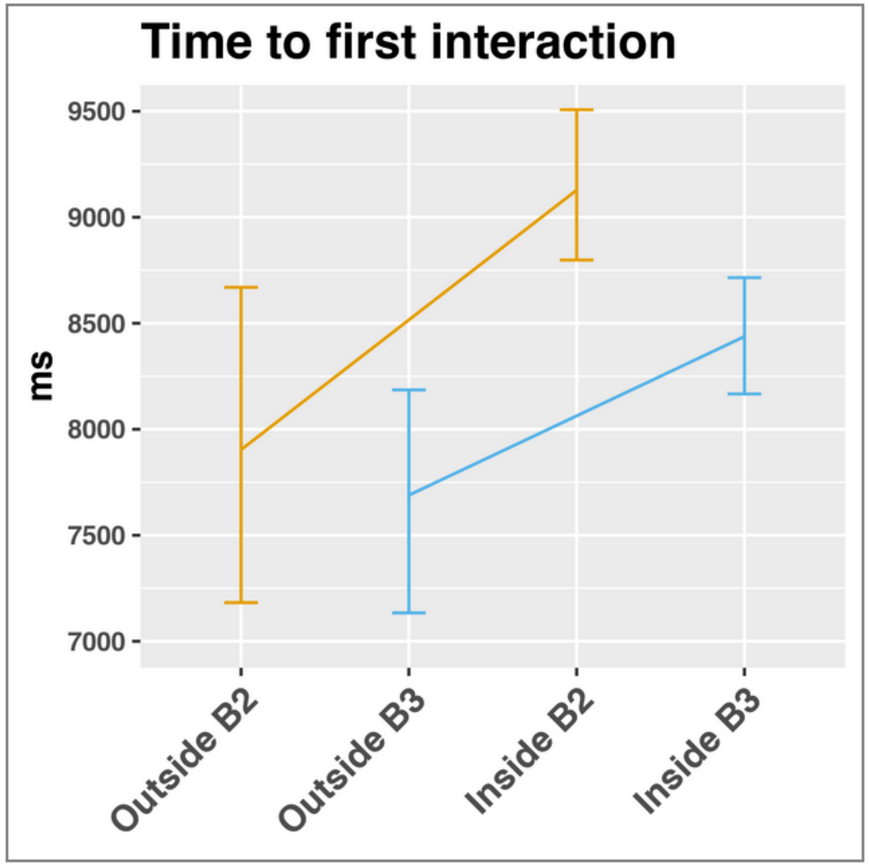




- Longer scanning times and scanpath lengths, as expected

- Results — Interactions



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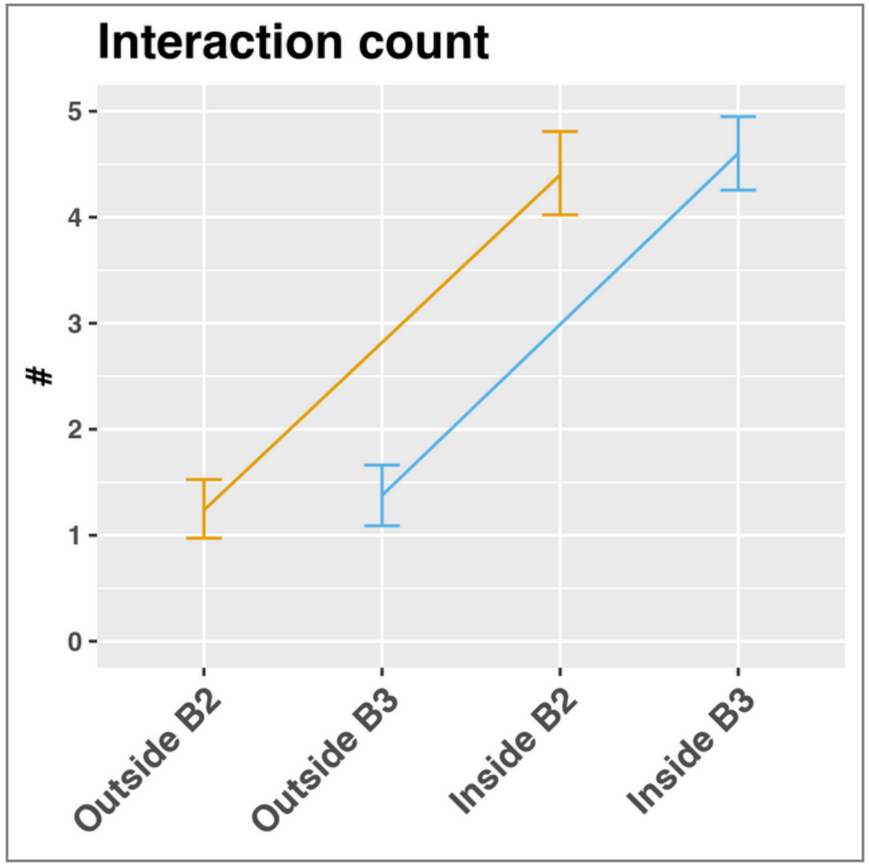

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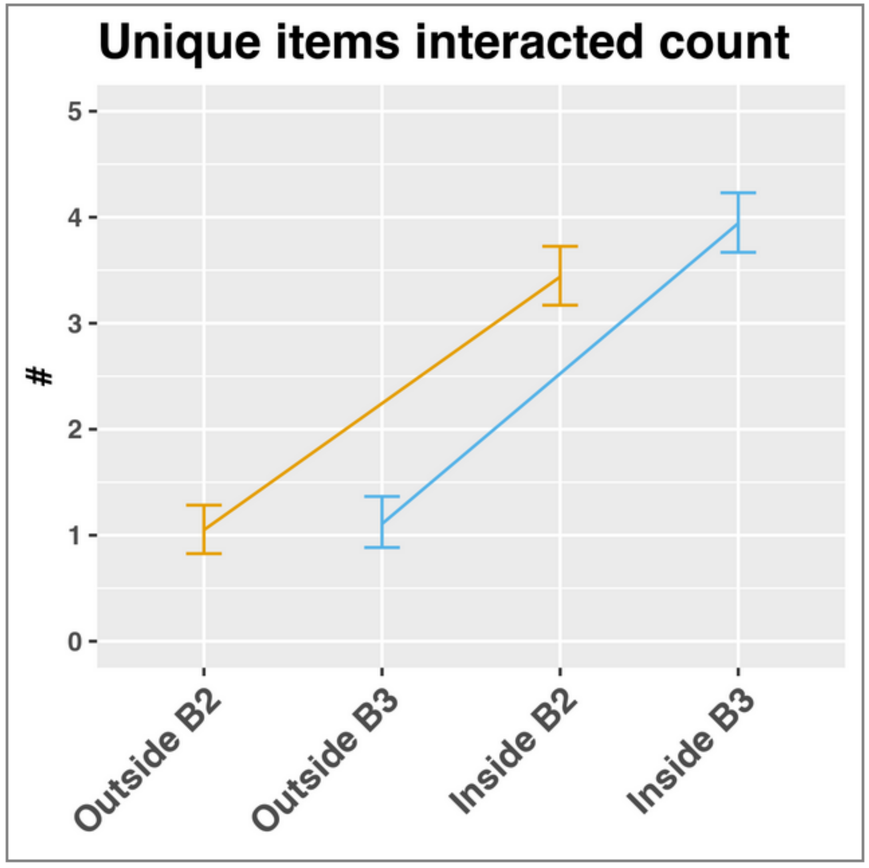

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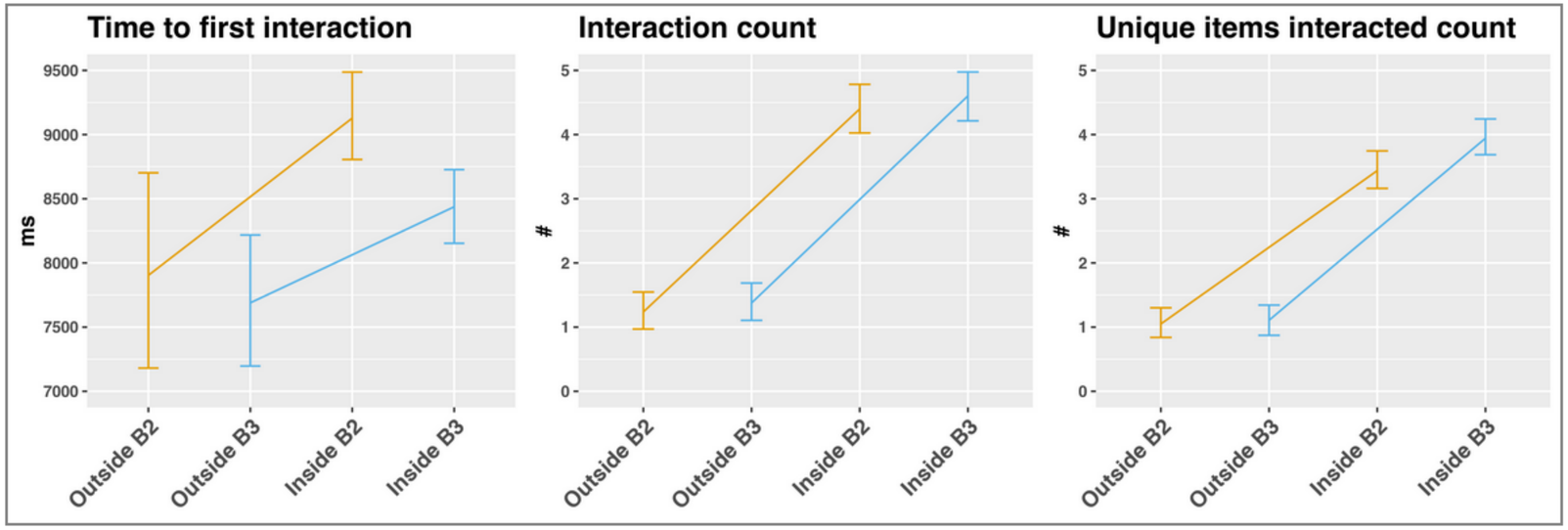

- First interaction happened quite late on average
- searched outside first then started opening containers

Participants interacted in 22% of "outside" trials. (and in 90% of "inside" trials)

- Main finding

No real strategy shift for participants

➜ Search outside first

Fairly optimal in terms of energy expenditure

For a 50% inside/outside protocol