

Disorganization impairs cognitive maps built from visual inputs

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Background

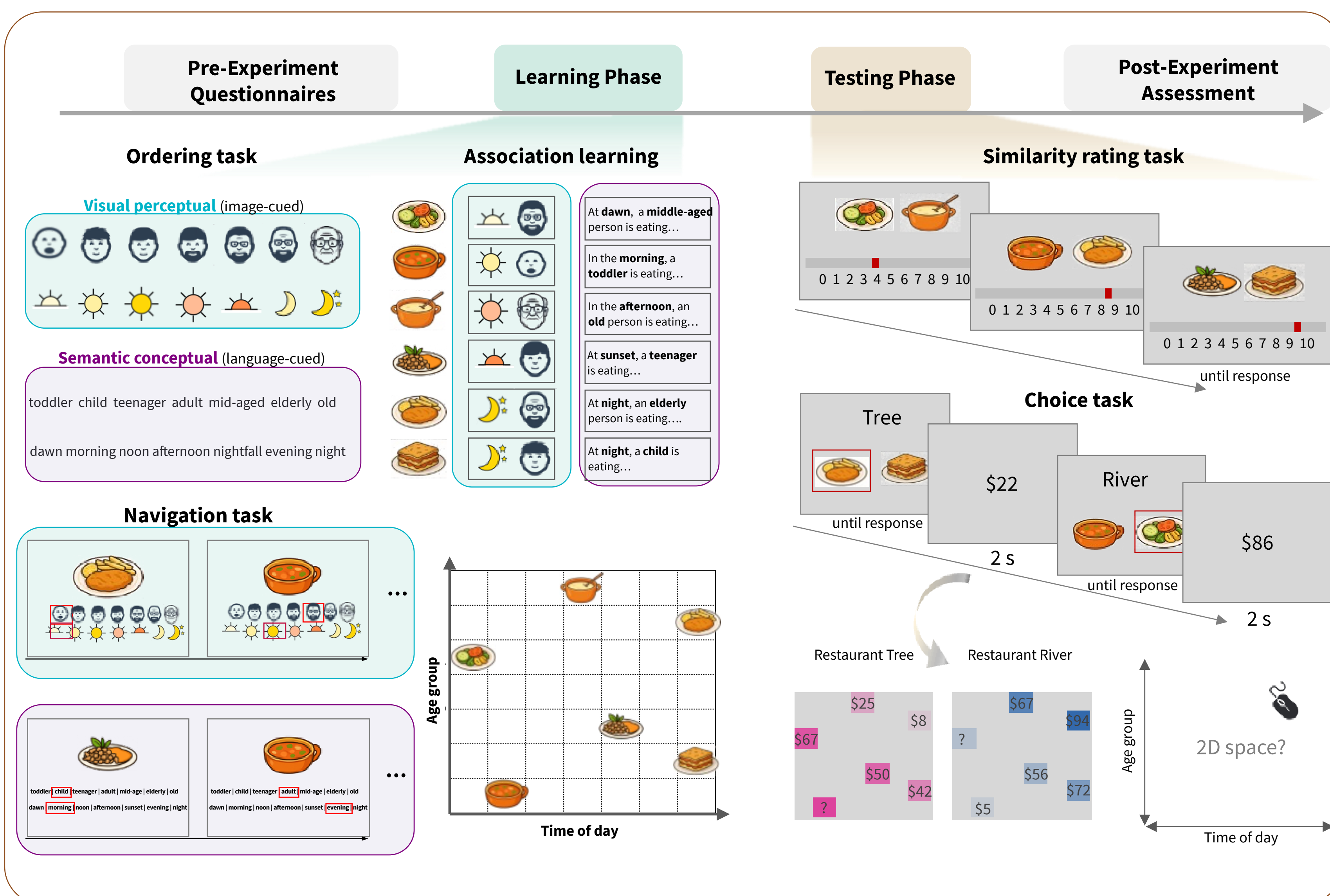
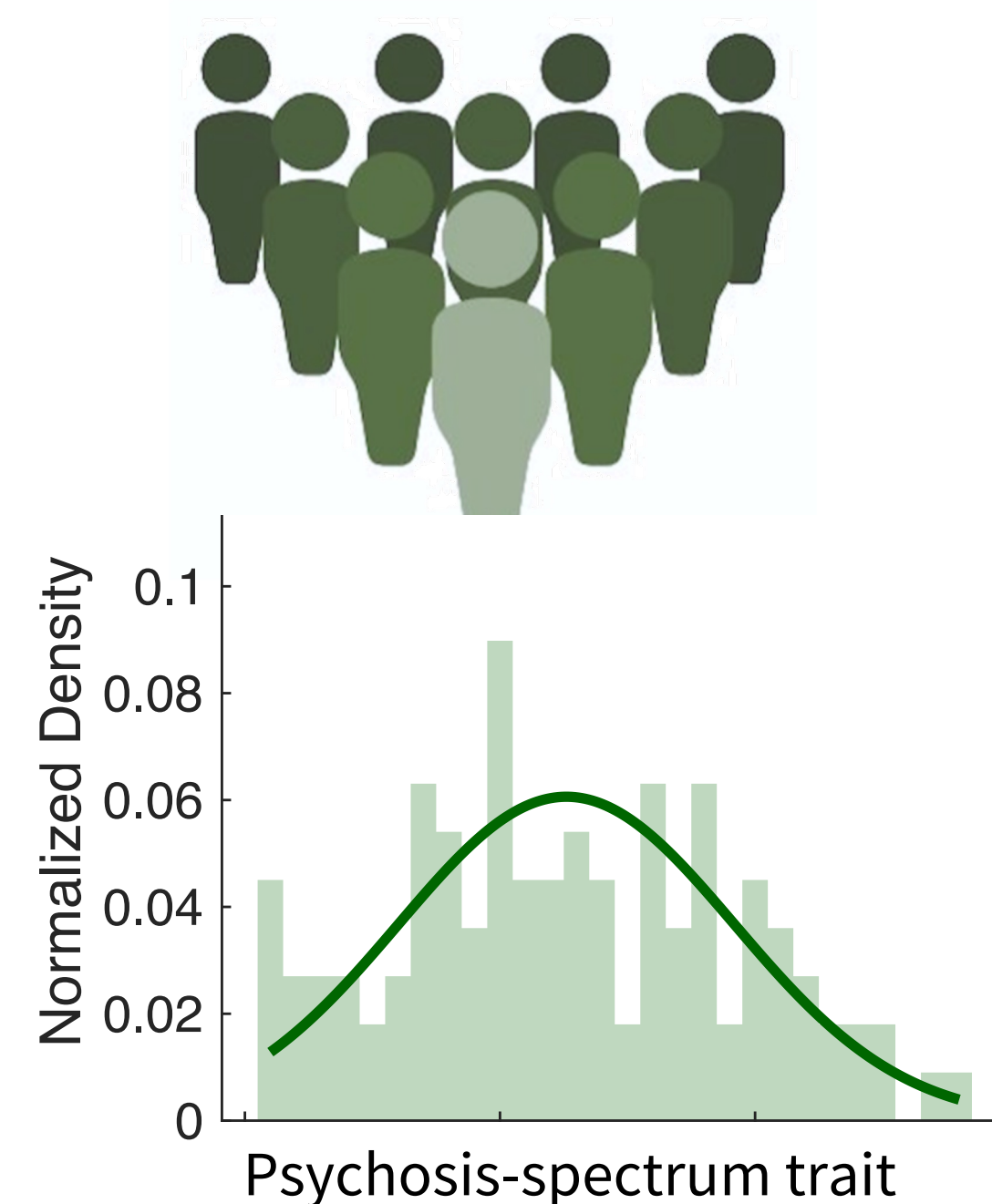
Humans construct **cognitive maps**¹ to organize fragmented experiences into relational structures that support inference and generalization². Psychosis-spectrum cognitive disorganization has been thought to reflect instability in cognitive representations, as proposed by the **shallow cognitive map hypothesis**^{3,4}. However, it remains unclear **whether this vulnerability depends on input modality**. Here, we test whether cognitive disorganization selectively impairs map construction **from visual inputs**, compared to when equivalent relational structure is provided **through language**.

Methods

Participants with different levels of *psychosis-spectrum trait* learned associations between the age groups, times of day and food items represented by either **image-based** (n=51) or **language-based** (n=60) stimuli.

Similarity judgments tested whether they integrated these dimensions into a 2D abstract space.

In a reward task, choices depended on items' map positions. Computational modeling (Spatial Gaussian process⁵) examined whether participants exploited spatial structure to generalize rewards and guide decisions.



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Results

Behavioral results

Reduced spatial sensitivity with higher *cognitive disorganization* in **image-based** condition.

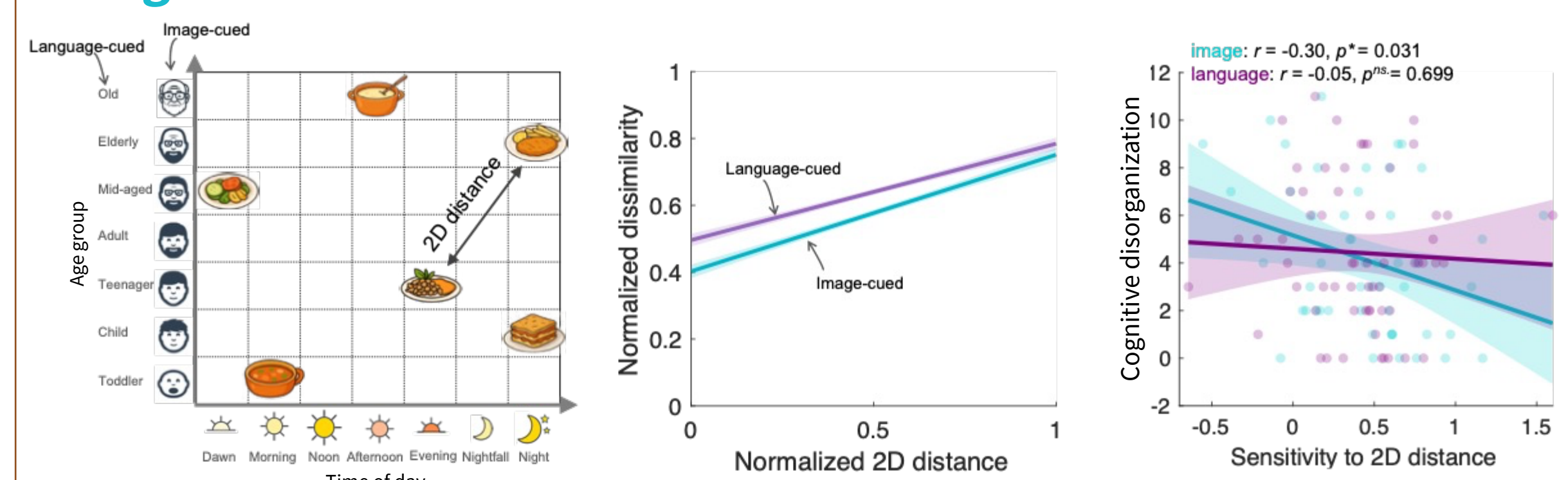
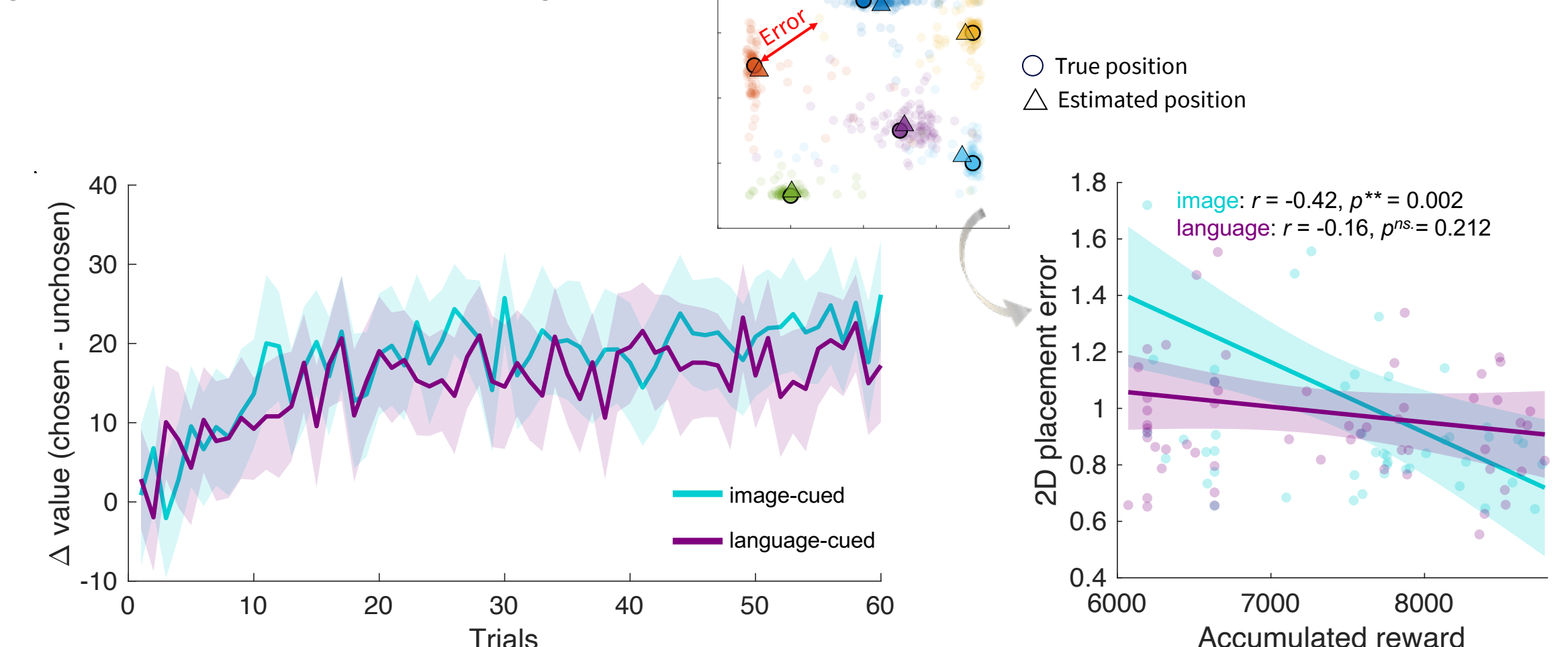
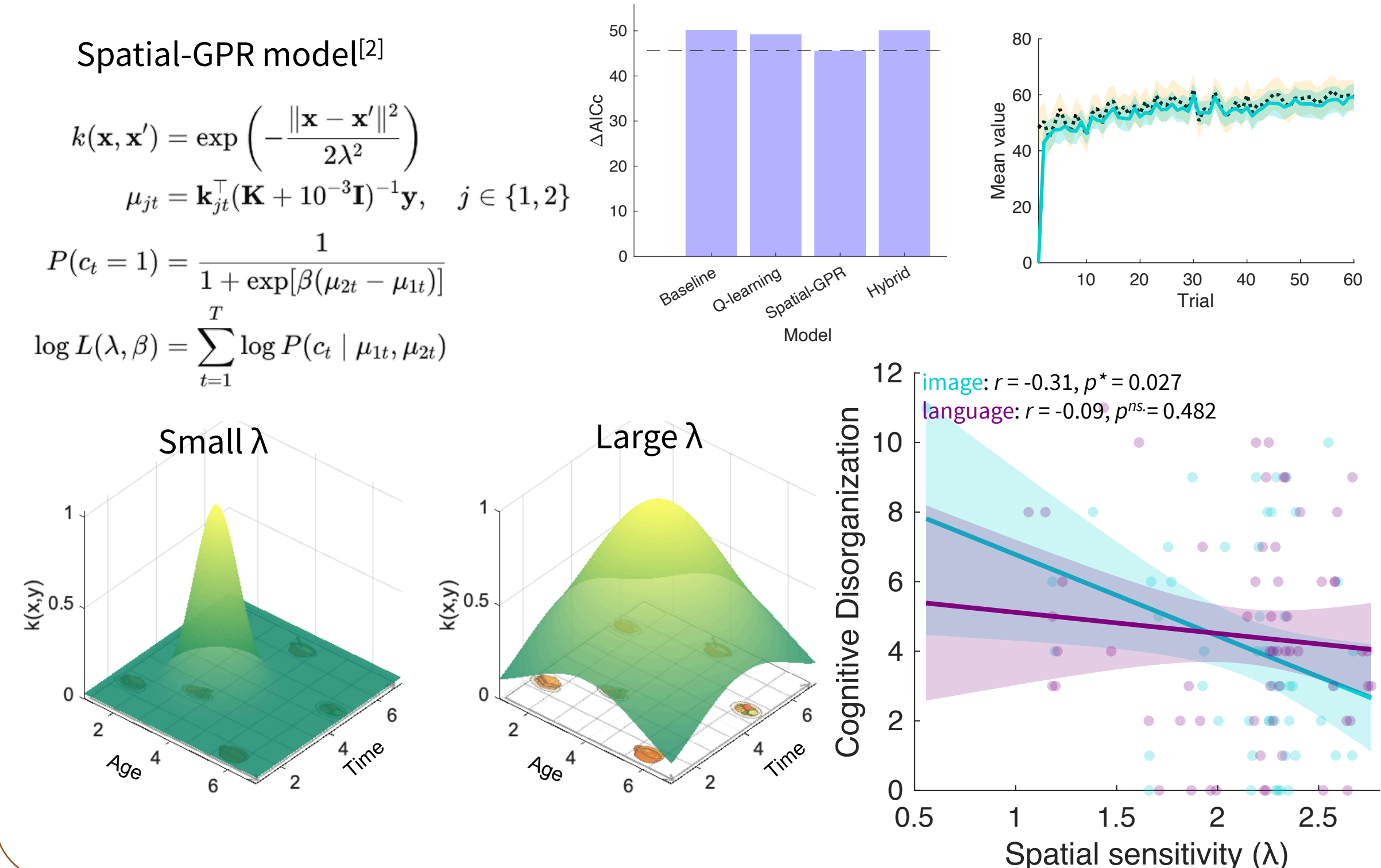


Fig.2. Analysis results from similarity rating task.



Computational modeling

Internal spatial representation guides value-based decisions. *Cognitive disorganization*-related attenuation of spatial generalization was observed only in **image-based** condition.



Key takeaways

- Participants formed and used **latent 2D cognitive maps** by fragmented learning to guide similarity judgments and reward-guided decisions.
- Higher levels of cognitive disorganization **selectively reduced spatial sensitivity** and **spatial generalization** when maps were derived from **visual inputs**, but not from **language**.
- Computational modeling revealed that **narrower spatial generalization kernels** in reward-guided decision correlated with higher levels of disorganization only when maps must be derived from **visual inputs**.
- Language provides a **structured relational scaffold** that buffers against impairments in percept-to-structure transformation.
- Results support the **shallow cognitive map hypothesis** and identify a specific percept-to-structure vulnerability in psychosis-spectrum disorganization.
- Clinical utility**

These results indicate that cognitive disorganization selectively disrupts the transformation of visual input into stable relational structure, rather than general reasoning ability. The preserved performance under language input suggests that explicit linguistic structure can bypass a vulnerable computational stage in map construction. Enhancing verbal scaffolding and symbolic structure may support learning and generalization in individuals with elevated psychosis-spectrum disorganization.