Is my kitchen your kitchen?

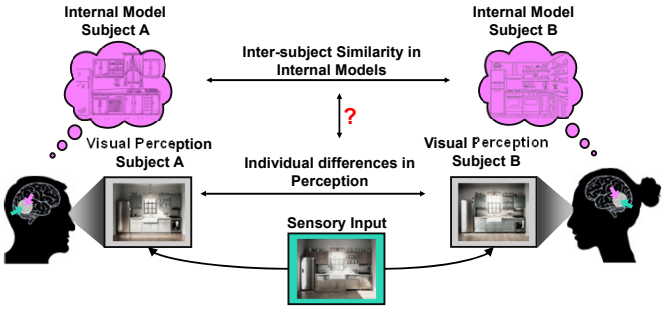
Explaining Idiosyncrasies in Scene Perception and Exploration Through Individual Differences in Internal Models.

Micha Engeser[1,2,3], Daniel Kaiser[1,3]

1 Mathematical Institute, Department of Mathematics and Computer Science, Physics, Geography, Justus-Liebig-Universität Gießen, Germany
2 Neural Circuits, Consciousness and Cognition Research Group, Max Planck Institute for Empirical Aesthetics, Frankfurt am Main, Germany
3 Center for Mind, Brain and Behavior (CMBB), Philipps-Universität Marburg and Justus-Liebig-Universität Gießen, Marburg, Germany

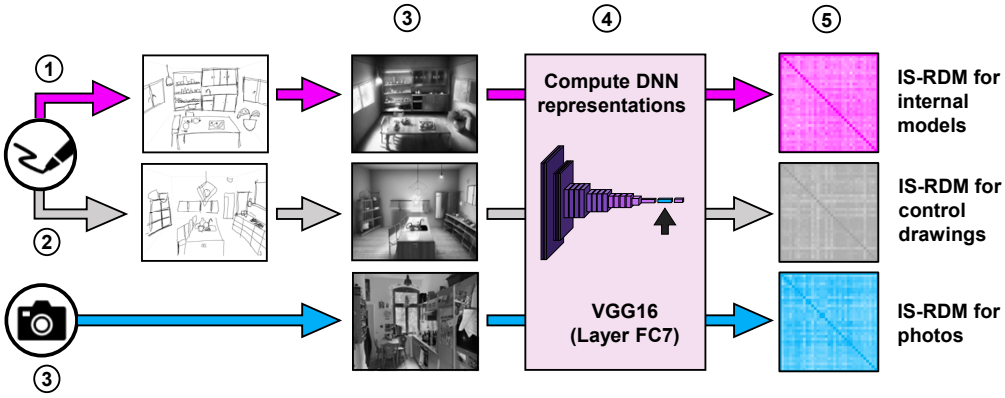
INTRODUCTION – How can we explain individual differences in visual perception?

- According to **predictive processing theories**, visual perception is efficient when inputs align well with **internal models** of the world.
- Previous studies demonstrated **drawings** might be used as behavioral read-outs of internal models (Wang et al. 2024, *Cognition*; Wang et al. 2025, *Proceedings B*).
- Reliable individual differences in visual perception and gaze behavior have been established (de Haas et al. 2019, *PNAS*).
- **Can these idiosyncrasies in visual perception and scene exploration be predicted through inter-individual differences in internal models?**



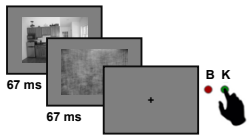
METHOD – Characterizing internal models

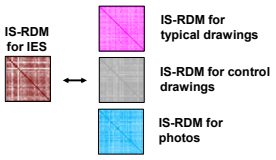
1. Participants **drew personal typical exemplars** of indoor scene categories (i.e., kitchen) to categorize their **internal model** of that scene.
2. Participants **copied** a scene as a **control condition.**
3. Generate **photorealistic image** from drawings using the draw3D generative AI tool.
4. Estimate **pairwise similarities** between drawings by correlating **late-layer representations** of a **deep neural network.**
5. Store **pairwise similarities** between subjects in **inter-subject representational dissimilarity matrix (IS-RDM).**
6. Participants provide **photos** of their own rooms which are processed through the same pipeline.



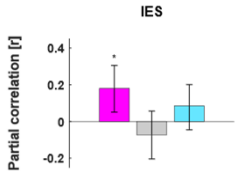
RESULTS – Predicting inter-subject similarities in scene perception through inter-subject similarities in internal models

A Inter-subject correlation of categorization performance (IES) across images of kitchens and bathrooms

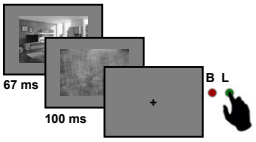


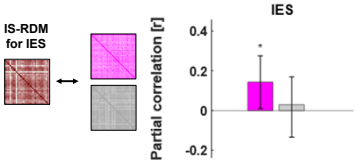


Partial correlation between IS-RDMs of IES and drawings

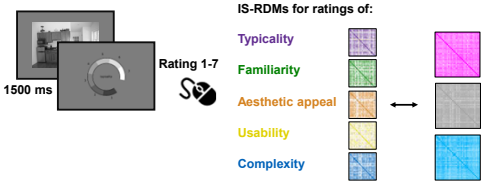


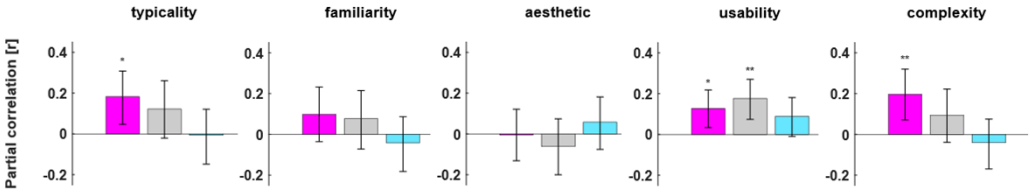
B Preregistered replication of the correlation between categorization performance and drawings (using bedroom and living room images)





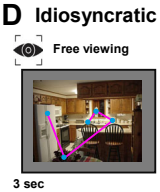
C Inter-subject correlation of subjective ratings across images

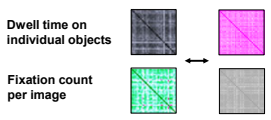


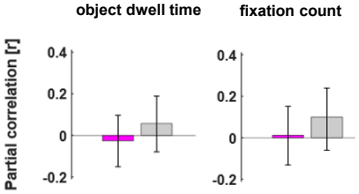


RESULTS – Predicting inter-subject similarities in scene exploration

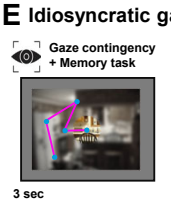
D Idiosyncratic gaze behavior during free viewing

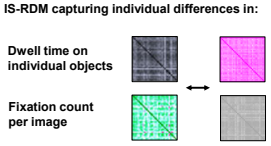


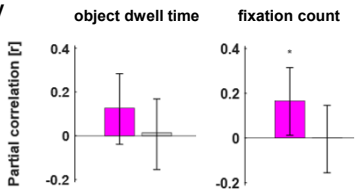




E Idiosyncratic gaze behavior under gaze contingency







CONCLUSION

- Shared **inter-individual differences** in **internal models** and **categorization performance.**
- **Inter-individual differences** in **internal models** also predicted similarities in perceived typicality, usability, and complexity.
- Idiosyncrasies in **gaze dynamics** can only be predicted when participants are encouraged to explore scenes strategically through gaze contingency.
- More work is needed to investigate how internal models guide object fixation.
- **Individuals with more similar internal models perceive and explore the world in more similar ways.**

PDF of Poster:

contact: michaengeser@gmail.com