Representations of Scene Beauty in Space and Time: DFG **An EEG-fMRI Fusion Study** JUSTUS-LIEBIG-UNIVERSITÄT

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BACKGROUND

GIESSEN

- Aesthetic experiences are common in everyday life, warranting their study using naturalistic stimuli (e.g., scenes) rather than (only) artworks
- Visual aesthetic experiences involve brain processes linked to perception, executive control, reward/pleasure, and self-referential cognition [1,2]
- Representations of beauty emerge during perceptual processing and are sustained in time [3-5]
- Aim of the study: Resolve the neural correlates of scene beauty across space and time, providing an integrative view of the neural processing cascade

EEG-fMRI FUSION: METHODS



METHODS

• N = 29 fMRI participants and N = 52 EEG participants viewed and rated the beauty of 100 scene photographs DefaultC ContA



 Using RSA [6] and variance partitioning [7], we performed EEG-fMRI fusion in 50 brain parcels (see right; [8])—i.e., we combined the EEG and fMRI data into a time course of beauty representation for each parcel



EEG-fMRI FUSION: RESULTS

ParOper

VisCent1

VisCent2

VisCent3

VisCent4

PrCv

PCC

pCun

PFCm

PFCd

PFCv

Temp1

Temp2

TempOcc

SPI

Temp

PFCI

Temp

SomMotA

VisCent4

Temp

Distributed representations of beauty share a common format



Representations of beauty widespread



0.6 0.8

Time (s)

Commonality Time Courses

1.0



Temp

REPRESENTATIONAL SIMILARITY ANALYSIS



- late visual cortex
 - Searchlight RSA: spherical searchlight of 300 voxels
 - predict beauty ratings
- EEG RSA: representations of beauty



- across cortex
- Similar representational dynamics in all parcels



R²VGG16 Features Regress out 1234 וֹידֿידֿיד $\mathsf{R}^2_{\mathsf{Image}\,\mathsf{Quality}}$ Degree to which visual features not related to beauty affect results unclear

- Therefore, regress out:
- Image-quality ratings (from separate group of N = 43 participants; [9]) VGG16 [10] feature weights





References

[1] Chatterjee, A., & Vartanian, O., 2014. TiCS, 18(7), 370–5. [2] Starr, G., 2023. FrontHumNeurosci, 17. [3] Kaiser, D., 2022. JCognNeurosci, 34(10), 1988–97. [4] Kaiser, D., 2022. JNeurophysiol, 128(6), 1501–5. [5] Kaiser, D., & Nyga, K., 2020. SciRep, 10(1). [6] Kriegeskorte, N., Mur, M., & Bandettini, P. A., 2008. FrontSysNeurosci, 2. [7] Hebart, M. N., Bankson, B. B., Harel, A., Baker, C. I., & Cichy, R. M., 2018. eLife, 7. [8] Yan, X., Kong, R., Xue, A., Yang, Q., An, L., Holmes, A. J., ... Yeo, B. T. T., 2023. NeuroImage, 273. [9] Tinio, P. P., Leder, H., & Strasser, M., 2011. PsycholAesthetCreatArts, 5(2), 165–76. [10] Simonyan, K., & Zisserman, A., 2015. arXiv:1409.1556.

Majority of apex cognitive networks (control, default-mode, salience) retained sustained, significant commonality time courses

0 0.2 0.4 0.6 0.8 1.0 1.2 1.4

Time (s)

Unchanged representational dynamics after accounting for visual information

CONCLUSION

- Representations of beauty are characterized by similar dynamics across cortex
 - Perceptual and cognitive correlates of beauty likely emerge in tandem across the neural processing cascade
 - Suggests perceptual basis of representations of beauty
- Representations of beauty are not exhaustively explained by perceptual information
 - Accounting for visual features did not change representational dynamics, suggesting shared representational format for beauty across cortex

Browser version of the poster

