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# Paul S. Scotti, Ph.D

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## EXPERIENCE & EDUCATION

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### Stability AI

Nov. 2023 – Present

Head of NeuroAI, Principal Investigator of the MedARC Neuroimaging & AI Lab (<https://medarc.ai/fmri>)

Published in NeurIPS and ICML, reconstructing seen images from fMRI brain activity using contrastive learning and denoising diffusion models. Fine-tuned the Stable Diffusion XL model to attain SOTA unCLIP performance.

### Princeton Neuroscience Institute

Visiting research scientist

Nov. 2023 – Present

Postdoctoral research associate (PI: Dr. Ken Norman)

Apr. 2022 – Nov. 2023

Collaborating with Princeton labs on open research AI projects, training a foundation model on large-scale brain data.

### The Ohio State University

Oct. 2017 – Apr. 2022

Vision and Cognitive Neuroscience Lab | Cognitive Control Lab (PI: Dr. Julie Golomb | Dr. Andy Leber)

Ph.D. dissertation on “Computational Models to Observe Visual Memory Distortions and Reconstruct Content from the Brain”

### The George Washington University

Sep. 2014 – May 2017

Attention and Cognition Lab | Visual Cognition Lab (PI: Dr. Sarah Shomstein | Dr. Steve Mitroff)

Undergraduate researcher (distinguished/honors scholar, magna cum laude, [2017 commencement speaker](#))

## GRANTS, FELLOWSHIPS, & AWARDS

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- Princeton Innovation Fund for New Industrial Collaborations (\$250,000)
- NSF Graduate Research Fellowship (\$102,000)
- OSU University Fellowship (\$26,316)
- Luther Rice Undergraduate Research Fellowship

## PRESS

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- FujiFilm collaboration: mental imagery reconstruction
- Cognitive Revolution Podcast on mind reading
- Established industrial partnership between Stability AI x Princeton University to support neuroAI
- Our work mentioned in US Senate hearing on AI and Intellectual Property

## PROJECTS (curated selection)

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### MindEye2: Shared-Subject Models Enable fMRI-To-Image With 1 Hour of Data

First-author publication in ICML 2024

- SOTA performance in reconstruction of seen images from fMRI brain activity
- Novel approach to shared-subject modeling enables high-quality results with 40x less training data
- Fine-tuned Stable Diffusion XL to achieve SOTA unCLIP performance

### Reconstructing the Mind’s Eye: fMRI-to-Image with Contrastive Learning and Diffusion Priors

First-author publication in NeurIPS 2023 (spotlight)

- Novel soft contrastive loss inspired by knowledge distillation
- Large-scale FAISS retrieval from brain embeddings to image embeddings nearest neighbor

### AI Alibis: Multi-Agent LLM Murder Mystery (reached #1 on Hacker News)

Open-source browser game demonstrating novel prompting techniques to bypass pink elephant problem in LLMs

- Used by the state police of Germany (NRW) for Gamescom convention (modified for translation + branding)

### EduCortex: Browser-Based 3D Brain Visualization of fMRI Meta-Analysis Maps

First-author publications in JOSE 2020 and Frontiers for Young Minds 2021

- Browser-based visualization of human brain to help users understand brain anatomy and functional specialization

### Enhanced Inverted Encoding Modeling for Neural Reconstructions

- Created a python package for neuroimaging stimulus reconstructions via inverted encoding modeling (PyPI)

## SKILLS

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- Python, PyTorch
  - neural networks, large language models, denoising diffusion models, encoding/decoding models
  - multi-node / multi-gpu distributed training (DDP, FSDP, Deepspeed)
- HPC computing / cloud computing
  - Slurm HPCs, Amazon ECS, Microsoft Azure
  - created webdataset format large-scale datasets stored on AWS s3 to support large-scale model training
- Computational neuroimaging (fMRI and behavioral)
  - designing experiments, collecting data, pre-/post-processing; SPM, FSL, AFNI, Nipype, Freesurfer, Fmriprep
- Front-end web development (HTML, CSS, JavaScript, Node.js, React)
- Hierarchical Bayesian modeling (PyMC3, JAGS)
- Eye-tracking (experience using/designing behavioral psychology experiments for EyeLink 1000 Plus)

## MENTORSHIP

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Seungwan (Kevin) Son, Stephenie Chen, Karit (Keith) Matanachai, Ashutosh Narang, Cesar Torrico, Mihir Tripathy, Atmadeep Banerjee, Stepan Shabalin, David Weisberg, Foyez Alauddin, Nathalie Verlinde, Anisha Babu, Molly McKinney

## AD HOC REVIEWING

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Nature Neuroscience; NeuroImage; Communications Biology; Imaging Neuroscience; Scientific Reports; Psychonomic Bulletin & Review; Journal of Experimental Psychology: General; Journal of Experimental Psychology: Learning, Memory, and Cognition; Attention, Perception, & Psychophysics; Memory; Memory & Cognition; Journal of Open Source Education

## OUTREACH / PROFESSIONAL DEVELOPMENT / TEACHING

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- MedARC, Principal investigator of the Neuroimaging & AI Lab 2023 – Present  
Leading neuroimaging open research projects, mentoring international online community of volunteers
- fMRI Playground: Simple summaries & simulations of neuroimaging methods 2023  
Interactive textbook on computational neuroimaging methods using Python examples with simulated data
- OnNeuro, Founder 2017 – 2022  
Hosting/sharing open-access research talks in the fields of psychology and neuroscience
- Center for Cognitive and Behavioral Brain Imaging Student Org, Technical Director 2017 – 2022  
Organizing interdisciplinary workshops and guest speaker presentations at Ohio State Univ.
- Center for Cognitive and Brain Sciences Undergraduate Summer Institute (CUSI) 2018/2019/2021  
Lectured on lab organization, questionable research practices, open science, and pre-registration
- NeuroHackademy Summer 2019  
Led a team of researchers to create [EduCortex](#), an educational brain viewer
- Guest Lecturer (Ohio State University) Fall 2019  
Introduction to Psychology (PSYCH 1001)
- Course Assistant (Ohio State University)
  - Sensation and Perception (PSYCH 3310) Spring 2019
  - Cognitive Psychology Laboratory (PSYCH 4510) 2018 – 2019
  - Introduction to Social Psychology (PSYCH 3325) Autumn 2018

## PUBLICATIONS

1. Luppi, A., Achterberg, J., Schmidgall, S., Bilgin, I., Herholz, P., Sprang, M., Fockter, B., Ham, A., Thorat, S., Ziaei, R., Milisav, F., Proca, A., Tolle, H., Suarez, L., **Scotti, P.S.**, & Gellersen, H. (In Press). Trainees' perspectives and recommendations for catalyzing the next generation of NeuroAI researchers. *Nature Communications*.
2. **Scotti, P. S.**, Tripathy, M., Torrico, C., Kneeland, R., Chen, T., Narang, A., Santhirasegaran, C., Xu, J., Naselaris, T., Norman, K. A., & Abraham, T. M. (2024). MindEye2: Shared-Subject Models Enable fMRI-To-Image With 1 Hour of Data. *ICML*. doi.org/10.48550/arXiv.2403.11207.
3. **Scotti, P. S.**, Banerjee, A., Goode, J., Shabalin, S., Nguyen, A., Cohen, E., Dempster, A. J., Verlinde, N., Yundler, E., Weisberg, D., Norman, K. A., & Abraham, T. M. (2023). Reconstructing the Mind's Eye: fMRI-to-Image with Contrastive Learning and Diffusion Priors. *NeurIPS spotlight*. doi.org/10.48550/arXiv.2305.18274. *US Senate hearing on AI and Intellectual Property discusses our work as an example AI medical application*.
4. Babu, A., **Scotti, P. S.**, & Golomb, J. D. (2023). The dominance of spatial information in object identity judgments: A persistent congruency bias even amidst conflicting statistical regularities. *Journal of Experimental Psychology: Human Perception and Performance*. doi.org/10.1037/xhp0001104
5. Wallace, G., Polcyn, S., Brooks, P. P., Mennen, A., Zhao, K., **Scotti, P. S.**, Michelmann, S., Li, K., Turk-Browne, N. B., Cohen, J. D., Norman, K. A. (2022). RT-Cloud: A Cloud-based Software Framework to Simplify and Standardize Real-Time fMRI. *NeuroImage*. doi.org/10.1016/j.neuroimage.2022.119295
6. **Scotti, P. S.**, Chen, J., & Golomb, J. D. (2022). An improved method for evaluating inverted encoding models. *bioRxiv*. doi.org/10.1101/2021.05.22.445245.
7. **Scotti, P. S.** & Maxcey, A. M. (2022). Directed forgetting of pictures of everyday objects. *Journal of Vision*. doi.org/10.1167/jov.22.10.8
8. Maxcey, A. M., Mancuso, E., **Scotti, P. S.**, Spinelli, E., & Woodman, G. F. (2022). How to induce the forgetting of pictures. *Visual Memory* (Routledge). Eds. Wilma Bainbridge & Timothy Brady. ISBN 9780367744878.
9. **Scotti, P. S.**, Kulkarni, A., Mazor, M., Klapwijk, E., Huth, A. G. (2021). Interactive 3d brain helps you learn how the brain is organized. *Frontiers for Young Minds*. doi.org/10.3389/frym.2021.575131
10. **Scotti, P. S.**, Chen, J., & Golomb, J. D. (2021). An enhanced inverted encoding model for neural reconstructions. *bioRxiv*. doi.org/10.1101/2021.05.22.445245
11. **Scotti, P.S.** & Maxcey, A. M. (2021). What do laboratory-forgetting paradigms tell us about use-inspired forgetting? *Cognitive Research: Principles and Implications*. doi.org/10.1186/s41235-021-00300-6
12. Chen, J., **Scotti, P. S.**, Dowd, E. W., & Golomb, J. D. (2021). Neural representations of task-relevant and task-irrelevant features of attended objects. *bioRxiv*. doi.org/10.1101/2021.05.21.445168
13. **Scotti, P. S.**, Hong, Y., Leber, A. B., & Golomb, J. D. (2021). Visual working memory items drift apart due to active, not passive, maintenance. *Journal of Experimental Psychology: General*. doi.org/10.1037/xge0000890
14. **Scotti, P. S.**, Hong, Y., Golomb, J. D., & Leber, A. B. (2021). Statistical regularities as a reference point for memory distortions: Swap and shift errors. *Attention, Perception, & Psychophysics*, 1-21. doi.org/10.3758/s13414-020-02236-3
15. **Scotti, P. S.**, Kulkarni, A., Mazor, M., Klapwijk, E., Yarkoni, T., Huth, A. G. (2020). EduCortex: browser-based 3D brain visualization of fMRI meta-analysis maps. *Journal of Open Source Education*, 3(26), 75. doi.org/10.21105/jose.00075
16. **Scotti, P. S.**, Janakieski, L., & Maxcey, A. M. (2020). Recognition-induced forgetting of schematically related pictures. *Psychonomic Bulletin & Review*, 27, 357–365. doi.org/10.3758/s13423-019-01693-8
17. **Scotti, P. S.**, Collegio, A., & Shomstein, S. (2019). Object-based attention is resilient to low-level (boundary) or high-level (semantic) disturbances, but not both. *PsyArXiv*. doi.org/10.31234/osf.io/vxqju
18. Collegio, A., Nah, J., **Scotti, P. S.**, & Shomstein, S. (2019). Attention scales according to inferred real-world object size. *Nature Human Behavior*, 3(1), 40-47. doi.org/10.1038/s41562-018-0485-2

## TALK / POSTER PRESENTATIONS (talks/workshops marked with \*)

1. **Scotti, P. S.**, Tripathy, M., Torrico, C., Kneeland, R., Chen, T., Narang, A., Santhirasegaran, C., Xu, J., Naselaris, T., Norman, K. A., & Abraham, T. M. (2024). MindEye2: Shared-Subject Models Enable fMRI-To-Image With 1 Hour of Data. *ICML*. Vienna, Austria.
2. **Scotti, P. S.**, Tripathy, M., Torrico, C., Kneeland, R., Chen, T., Narang, A., Santhirasegaran, C., Xu, J., Naselaris, T., Norman, K. A., & Abraham, T. M. (2024). MindEye2: Shared-Subject Models Enable fMRI-To-Image With 1 Hour of Data. *ICLR Workshop on Representational Alignment (Re-Align)*. Vienna, Austria.
3. **Scotti, P. S.**, Banerjee, A., Goode, J., Shabalin, S., Nguyen, A., Cohen, E., Dempster, A. J., Verlinde, N., Yundler, E., Weisberg, D., Norman, K. A., & Abraham, T. M. (2023). Reconstructing the Mind's Eye: fMRI-to-Image with Contrastive Learning and Diffusion Priors. *NeurIPS*. New Orleans, LA.
4. **Scotti, P. S.**, Hennings, A. C., Wallace, G., Polcyn, S., Brooks, P. P., Mennen, A., Zhao, K., Michelmann, S., Li, K., Turk-Browne, N. B., Cohen, J. D., Norman, K. A. (2023). Cloud-based Software Framework to Simplify and Standardize Real-time fMRI. *BRAIN Initiative*. Bethesda, MD.
5. \***Scotti, P. S.**, Hennings, A. C., Norman, K. A.. Conducting RT-fMRI Studies with the Realtime fMRI Cloud Framework (RT-Cloud). *Real-Time Functional Imaging and Neurofeedback Meeting*. New Haven, CT.
6. Wallace, G., **Scotti, P. S.**, Polcyn, S., Brooks, P. P., Mennen, A., Zhao, K., Michelmann, S., Li, K., Turk-Browne, N. B., Cohen, J. D., Norman, K. A. (2022). Cloud-based Software Framework to Simplify and Standardize Real-time fMRI. *BRAIN Initiative*. Virtual conference.
7. **Scotti, P. S.**, Chen, J., & Golomb, J. D. (2022, May). An enhanced inverted encoding model for neural reconstructions of visual perception, attention, and memory. *Vision Sciences Society*. Virtual conference.
8. **Scotti, P. S.**, Chen, J., & Golomb, J. D. (2021, June). An improved method for evaluating inverted encoding models. *Visual Working Memory Symposium*. Virtual conference.
9. **Scotti, P. S.**, Chen, J., & Golomb, J. D. (2021, May). An improved method for evaluating inverted encoding models. *Vision Sciences Society*. Virtual conference.
10. Chen, J., **Scotti, P. S.**, Dowd, E. W., & Golomb, J. D. (2021, May). Neural representations of task-relevant and task-irrelevant features of attended objects. *Vision Sciences Society*. Virtual conference.
11. **Scotti, P. S.**, Chen, J., & Golomb, J. D. (2021, March). An improved method for evaluating inverted encoding models. *Cognitive Neuroscience Society*. Virtual conference.
12. Jones, C. M., **Scotti, P. S.**, & Golomb, J. D. (2020, May). Feature-binding errors during saccadic remapping may affect perception of real-world objects. *Vision Sciences Society*. Virtual conference.

13. **Scotti, P. S.**, Kulkarni, A., Mazor, M., Klapwijk, E., Yarkoni, T., Huth, A. G. (2019, December). EduCortex: browser-based 3D brain visualization of fMRI meta-analysis maps. **Awarded best poster**, *Center for Cognitive and Behavioral Brain Imaging Annual Research Days*, Columbus, OH.
14. \***Scotti, P. S.**, Hong, Y., Leber, A., B., & Golomb, J. D. (2019, November). Competition between similar visual working memory items underlies repulsion effects. *Object Perception, Attention, and Memory (OPAM)*, Montreal, Quebec.
15. **Scotti, P. S.**, Janakiefski, L., & Maxcey, A. M. (2019, November). Recognition-Induced Forgetting Does Not Operate Over Superordinate Categories. *Psychonomic Society*, Montreal, Quebec.
16. **Scotti, P. S.**, Hong, Y., Leber, A., B., & Golomb, J. D. (2019, October). Competition Between Similar Visual Working Memory Items Produces Repulsion Effects. *Society for Neuroscience*, Chicago, IL.
17. **Scotti, P. S.**, Hong, Y., Golomb, J. D., Leber, A., B. (2019, May). Relational interactions between visual memory representations increase with maintenance duration. *Vision Sciences Society*, St. Pete Beach, FL.
18. Babu, A., **Scotti, P. S.**, Golomb, J. D. (2019, May). The dominance of spatial information in location judgments: A persistent congruency bias even amidst conflicting statistical regularities. *Vision Sciences Society*, St. Pete Beach, FL.
19. Janakiefski, L., Smerdell, M., **Scotti, P. S.**, Maxcey, A. (2019, March). Does recognition-induced forgetting operate over temporally-grouped objects? *CogFest*, Columbus, OH.
20. **Scotti, P. S.**, Hong, Y., Golomb, J. D., Leber, A., B. (2018, November). Statistical regularities during object encoding distort long-term memory. **Awarded best poster (\$200)**, *Object Perception, Attention, and Memory (OPAM)*, New Orleans, LA.
21. **Scotti, P. S.**, Hong, Y., Golomb, J. D., Leber, A., B. (2018, September). Statistical regularities during object encoding distort long-term memory. *Center for Cognitive and Brain Sciences Fall Retreat*, Mt. Sterling, OH.
22. **Scotti, P. S.**, Hong, Y., Golomb, J. D., Leber, A., B. (2018, May). Statistical regularities during object encoding distort long-term memory. *Vision Sciences Society*, St. Pete Beach, FL.
23. Adamo, S., Nah, J., Collegio, A., **Scotti, P. S.**, Shomstein, S. (2018, May). The flux capacitor account: A new theoretical account of multiple target visual search errors. *Vision Sciences Society*, St. Pete Beach, FL.
24. \*Collegio, A., Nah, J., **Scotti, P. S.**, Shomstein, S. (2017, November). Real-world object size affects attentional allocation. *Object Perception, Attention, and Memory (OPAM)*, Vancouver, BC.
25. **Scotti, P. S.**, Collegio, A., & Shomstein, S. (2017, November). Task-irrelevant object category guides attentional allocation. *Object Perception, Attention, and Memory (OPAM)*, Vancouver, BC.
26. **Scotti, P. S.**, Adamo, S., Mitroff, S., Shomstein, S. (2017, May). Repetition priming preferentially benefits infrequent targets. *Vision Sciences Society*, St. Pete Beach, FL.
27. Adamo, S., Nah, J., Collegio, A., **Scotti, P. S.**, Shomstein, S. (2017, May). Does orientation matter? Same or differently oriented targets in a multiple target search. *Vision Sciences Society*, St. Pete Beach, FL.
28. Collegio, A., Nah, J., **Scotti, P. S.**, Shomstein, S. (2017, May). Real-world object size affects attentional allocation. *Vision Sciences Society*, St. Pete Beach, FL.
29. **Scotti, P. S.**, Adamo, S., Mitroff, S., Shomstein, S. (2017, April). Repetition priming preferentially benefits infrequent targets. **1<sup>st</sup> place Psychology poster**, *GW Research Days event*, Washington, D.C.
30. **Scotti, P. S.**, Malcolm, G.L., Peterson, M., & Shomstein, S. (2016, November). Reality vs. Simplicity: The effects of real-world objects on attentional selection. *Object Perception, Attention, and Memory (OPAM)*, Boston, MA.
31. **Scotti, P. S.**, Malcolm, G.L., Peterson, M., & Shomstein, S. (2016, May). Reality vs. Simplicity: The effects of real-world objects on attentional selection. *Vision Sciences Society*, St. Pete Beach, FL.