David Coggan, Ph.D.

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Skills Summary

- **Languages**: proficient in Python, MATLAB, R; familiar with C++, LaTex, Bash, html
- **Tools**: proficient in PyTorch, pandas, git/github, opencv/PIL, matplotlib, ggplot, FSL, Freesurfer, Psychopy, PsychToolbox
- **Experimental techniques**: fMRI, EEG, MEG, behavioural, computational modeling
- **Machine learning**: Supervised and self-supervised learning, SVM, PCA, ICA, tSNE, k-means clustering
- **Computer vision (CV) tasks**: image classification, contrastive learning, image generation/augmentation
- **CV architectures**: feedforward/recurrent convolutional neural networks (CNNs), vision transformers, auto-encoders
- **Statistics**: ANOVA, permutation testing, multivariate and univariate analyses of neural data.
- **Other**: leading research teams, public speaking, academic writing, teaching, consultation, human subjects research

Experience

- **Postdoctoral Scholar** — Advisor: Prof. Frank Tong
  Vanderbilt University, Nashville, TN, USA — *March 2019 - present*
  - To improve robustness in computer vision models, I developed an 'occluder' dataset and pipeline that applies occlusion to any image dataset during training. This augmentation led to models that more accurately classified degraded images and better predicted human classification responses.
  - To understand the computations supporting visual robustness in humans, I created a set of human-alignment benchmarks by collecting human neural and behavioral responses to images of occluded objects. These benchmarks are publicly available, and the fMRI benchmark won the Brain-Score 2024 competition by producing the highest error in the top-ranked models.
  - Performed the first human investigation of a new network of cortical regions recently discovered in the brain of the macaque monkey. In humans, this network was embedded within other, previously discovered networks, revealing new functional roles performed by these regions. [Pub. 2]
- **Research Analyst**
  York Neuroimaging Centre, York, UK — *July 2017 - July 2018*
  - Analysis Consultant for research groups conducting neuroimaging experiments
  - Operated MRI scanners in both clinical and research settings and developed a training course for new operators.
  - Performed basic maintenance of MEG scanner, working with pressurized hazardous chemicals (liquid Helium)

Education

- **PhD, Cognitive Neuroscience and Neuroimaging** — Advisor: Prof. Tim Andrews
  University of York, York, UK — *October 2014 - February 2019*
  - Thesis explored how natural images such as faces, objects and scenes are represented in the brain. Utilized different neuroimaging (fMRI, EEG) and analysis techniques (GLM, MVPA, visual field mapping, SVM, PCA, ICA, k-means) to explore whether neural responses in high-level visual cortex could be explained by low-level principles. [Pubs. 3-7] (Python, MATLAB, Bash, FSL, FreeSurfer)
  - Pioneered the use of multivariate pattern analysis of EEG data to measure how distributed neural representations evolve over time. [Pub. 7]
  - Led research teams of Master's students in designing, conducting, analyzing, and reporting successful neuroimaging experiments. [Pubs. 3,4,6]
  - Collaborated with other research groups to conduct experiments beyond the scope of the PhD thesis. [Pub. 9]
- **MSc, Cognitive Neuroscience (Graduated with Distinction)** — Advisor: Prof. Tim Andrews
  University of York, York, UK — *September 2013 - August 2014*
  - Research project constituted an fMRI experiment which demonstrated that the appearance of complex, semantic representations in high-level visual cortex was in fact driven by more basic visual features. [Pub. 8] (fMRI, phase-scrambling, MVPA, FSL)
- **BSc, Psychology (Graduated with First-Class Honours)** — Advisor: Dr. Kris Kinsey
  University of the West of England, Bristol, UK — *September 2010 - June 2013*
  - Research project involved designing and animating novel 3D shapes to investigate the effect of viewpoint and depth-rotation on human object recognition. (Shade 3D, E-Prime)

Honours and Awards

- Brain-Score Competition 2024 Winner, MIT, Boston, MA, USA. Talk
- K M Stott Award for Best PhD thesis (2018/2019), University of York, York, UK
- Best Poster Presentation, Applied Vision Association (2018), University of Bradford, Bradford, UK

Voluntary Work / Public Outreach

- Peer reviewer for Imaging Neuroscience, iScience, NeuroImage, Scientific Reports
- Brain Blast (2022), Nashville Public Library, Vanderbilt Brain Institute, Nashville, TN, USA
- School for Science and Math at Vanderbilt (2020), Center for Science Outreach, Nashville, TN, USA
- Demo Night (2015-2017), Vision Sciences Society, St Pete Beach, FL, USA

Selected Publications

1. Coggan, D. D., & Tong, F. (Under Review). Evidence of strong amodal completion of occluded objects in both early and high-level visual cortex. *Journal of Neuroscience*.
2. Coggan, D. D., & Tong, F. (2023). Spikiness and animacy as potential organizing principles of human ventral visual cortex. *Cerebral Cortex*, 1-24. doi: 10.1093/cercor/bhad108
3. Coggan, D. D., Watson, D. M., Wang, A., Brownbridge, R., Ellis, C., Jones, K., . . . Andrews, T. J. (2022). The representation of shape and texture in category-selective regions of ventral-temporal cortex. *European Journal of Neuroscience*. doi: 10.1111/ejn.15737
4. Coggan, D. D., Giannakopoulou, A., Ali, S., Goz, B., Watson, D. M., Hartley, T., . . . Andrews, T. J. (2019). A data-driven approach to stimulus selection reveals an image-based representation of objects in high-level visual areas. *Human Brain Mapping*, *40*, 4716-4731. doi: 10.1002/hbm.24732
5. Coggan, D. D., Baker, D. H., & Andrews, T. J. (2019). Selectivity for mid-level properties of faces and places in the fusiform face area and parahippocampal place area. *European Journal of Neuroscience*, *49*, 1587-1596. doi: 10.1111/ejn.14327
6. Coggan, D. D., Allen, L. A., Farrar, O. R. H., Gouws, A. D., Morland, A. B., Baker, D. H., & Andrews, T. J. (2017). Differences in selectivity to natural images in early visual areas (v1 – v3). *Scientific Reports*, *7*, 1-8. doi: 10.1038/s41598-017-02569-4
7. Coggan, D. D., Baker, D. H., & Andrews, T. J. (2016). The role of visual and semantic properties in the emergence of category-specific patterns of neural response in the human brain. *eNeuro*, *3*, ENEURO.0158-16.2016. doi: 10.1523/ENEURO.0158-16.2016
8. Coggan, D. D., Liu, W., Baker, D. H., & Andrews, T. J. (2016). Category-selective patterns of neural response in the ventral visual pathway in the absence of categorical information. *NeuroImage*, *135*, 107-114. doi: 10.1167/15.12.622

Conference Talks

1. Coggan, D. D., Tong, F. (2024) DNNs fail to capture the representation of occluded objects in human visual cortex. Brain-Score Competition Winner Acceptance Talk, Computational Cognitive Neuroscience, Boston, MA, USA
2. Coggan, D. D., Tong, F. (2023) Unsupervised contrastive learning and supervised classification training have opposite effects on the human-likeness of CNNs during occluded object processing. Journal of Vision 23 (9), 5448
3. Coggan, D. D., Watson, D. M., ..., Andrews, T. J. (2018) The importance of low-level image properties in the neural representation of objects. Experimental Psychological Society (London, UK).
4. Coggan, D. D., Watson, D. M., ..., Andrews, T. J. (2017) A data-driven approach to stimulus selection reveals the importance of visual properties in the neural representation of objects. Journal of Vision 17 (10), 29.
5. Coggan, D. D., Watson, D. M., ..., Andrews, T. J. (2017) The importance of visual properties in the emergence of higher-level representations in the ventral visual pathway. Experimental Psychological Society (London, UK).
6. Coggan, D. D., Baker, D. H., Andrews, T. J. (2016) Investigating the temporal properties of visual object processing using a multivariate analysis of EEG data. Journal of Vision, 16 (12), 1311.

Selected Conference Posters

1. Coggan D. D., Tong, F. (2024) Naturalistic dataset augmentations lead to more human-like recognition of occluded objects in convolutional neural networks. Cognitive Computational Neuroscience, Boston, MA, USA
2. Coggan D. D., Tong, F. (2024) Naturalistic dataset augmentation and self-supervised learning lead to more human-like recognition of occluded objects in convolutional neural networks. Vision Sciences Society, Tampa, FL, USA
3. Coggan D. D., Tong, F. (2022) Occluded object completion occurs in full across human visual cortex but emerges gradually across layers of CORnet-S. Cognitive Computational Neuroscience, San Francisco, CA, USA
4. Coggan D. D., Tong, F. (2021) Maps of object animacy and aspect ratio in high-level visual cortex. Journal of Vision, 21(9), 2811.
5. Coggan, D. D., Watson, D. M., Hartley, T., Baker, D. H., Andrews, T. J. (2018) A data-driven approach to stimulus selection reveals the importance of visual properties in the neural representation of objects. Applied Vision Association, Bradford, UK