

# Towards a Standard Cortical Observer Model in V1-V3

Noah C. Benson<sup>1</sup>, Catherine Olsson<sup>2</sup>, William F. Broderick<sup>1</sup>, Jonathan Winawer<sup>1,2</sup>

<sup>1</sup>Department of Psychology and <sup>2</sup>Center for Neural Science New York University, New York, NY



#### Summary

A goal of visual neuroscience is the ability to predict cortical responses for a wide range of visual stimuli. We implemented a model that predicts fMRI responses in each voxel in V1, V2, and V3 to arbitrary, gray-scale images..

## Goals

- Unite anatomically-based models of retinotopy<sup>1,2</sup> with stimulus- and pRF-based models of cortical activity<sup>3</sup>
- Extend existing models<sup>3</sup> by adding multi-band support
- Provide tools and libraries for using, modifying, and implementing cortical models
- Create a public database and interactive site for sharing and comparing models and functional data

## Standard Cortical Observer Model

We extend the two-stage cascade model of Kay, Winawer *et al.*  $(2013)^3$ 









## Model and Software Availability

All software is freely available and is designed with modularity and customization in mind. We provide both a Github repository and a Docker image.

Additionally, we are developing a database and website that supports running SCO model calculations, uploading and storing relevant anatomical and functional data, comparing data with models, building/testing/modifying models, and collaborating across labs.

https://github.com/noahbenson/sco
Python library for predictions;
flexible interface designed for
modularity and extension



## Model Use Case 1: Prediction

The simplest use of the model is to make predictions from an uploaded subject and image set. Note that no parameter-fitting is required; these predictions are not learned.



## Model Use Case 2: Evaluation and Iteration

One can additionally upload functional data to evaluate our model or alternate parameterizations of our model.



Our upcoming data-sharing website will enable both use cases online.

#### Conclusions

- · We reproduce and extend previous models
- We provide a flexible framework for developing and communicating similar models
- We provide a community space for sharing data and developing forward models of the visual system

## References

- 1. Benson NC et al. (2012) Curr. Biol. 22:2081-5
- 2. Benson NC et al. (2014) PLoS Comput. Biol. 10:e1003538
- 3. Kay K et al. (2013) PLoS Comput. Biol. 9:e1003079
- 4. Dumoulin SO, Wandell BA (2008) Neuroimage 39:647-60
- 5. Kay KN et al. (2008) Nature 452:352-355