JONATHAN MONNEY

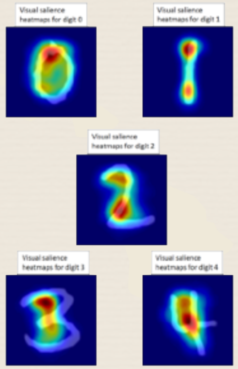
PROFILE & INTERESTS

After graduating from my BSc Hons. in Neuroscience (with distinction), I had the pleasure of being accepted to the Master of Science **Neuroimaging** course King's College London. During the coursework, my strong interests in **scientific communication** and **data visualisation** were reinforced. My research project allowed me to develop a new method of visualizing eye-tracking data, using parametric modeling commonly used in other neuroimaging modalities.

EXPERIENCE

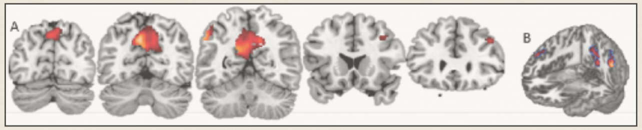
MSc in Neuroimaging Research Project:

Eyes Wide Open: A Behavioural and Computational Study of MNIST Digit Identification



For the love of #foodporn:

An fMRI study of food stimuli at varying levels of calorie content and color saturation



Scientific communication YouTube channel:

Project manager and co-creator of the Big Bright Brain (BBB) YouTube channel.

FUTURE PROJECTS

Taken with a passion for bridging the fields of neuroscience and artistic data visualisation along with an enthusiastic fondness for 3D modeling, a pet project of mine would be the development of an add-on for the open source software Blender.

This add-on would allow the user to extrude a 3D mesh from structural MRI data, and would help visualise data before, during, and after pre-processing. This would speed up statistical analyses by ensuring the use of a pipeline containing properly «cleaned-up» data, while also permitting preliminary inferences to be made from a comprehensive 3D model.

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ABSTRACT

Context: *Current deep convolution neural networks treat vision as a static sequential readout of pixel information. Active inference defines an agent's selection of policies (set of actions) as belief based. In sampling the environment, these beliefs are generatively update in order to minimize surprise.*

Objectives: *We hypothesize human vision to be based upon the active inference framework as we actively seek out salient visual features. Therefore, we infer human vision to be a topdown process based on our current beliefs about the environment.*

Methods: *A visual eye-tracking study was performed on healthy participants to analyse gaze scan paths in trying to identify a scene. The scenes contained partially obstructed handwritten digits from the MNIST database. To further test our hypothesis, we are developing a Markov Decision Process (MDP) computational model based on the active inference framework. The MNIST database was selected as this platform is a benchmark for computer vision algorithm testing. Behavioural data analysis was performed using a novel method we developed, taking inspiration from fMRI data analysis, whereby scan paths were converted to volumetric NIfTI format for SPM analysis.*

Results: *In all tasks, participants showed better performance in trial duration and less scene exploration when prior beliefs created an expected scene identity.*

Conclusions: *Our results support our hypothesis that human vision is a predictive top-down process, based on our prior beliefs, as per active inference. Results from our MDP model show how an agent learns to look for salient features for scene identification but is still in development.*

The full dissertation may be found here:
github.com/jonathanmonney/MSC_ActInf/blob/master/JM_thesis_N.pdf

NEUROIMAGING RESEARCH PROJECT

Eyes Wide Open: A Behavioural and Computational Study of MNIST Digit Identification

EXPERIMENTAL PARADIGM:

- Conception of experimental paradigm
- Coding of experimental paradigm (Matlab, Cogent 2000)
- Hardware & procedure set-up (EyeLink1000)
- Ethics approval & participant recruitment

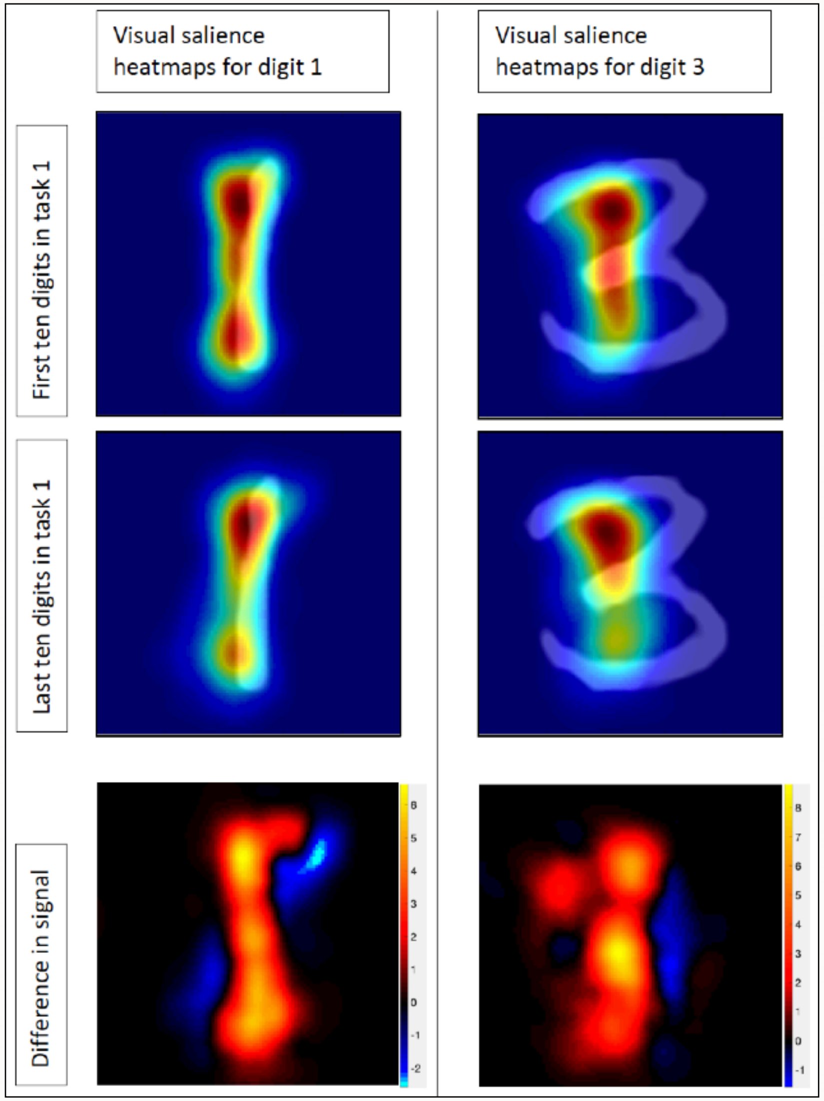
Videos of the results obtained may be found by following these links:

Task 1: Task 1 - video

Task 2: Task 2 - video

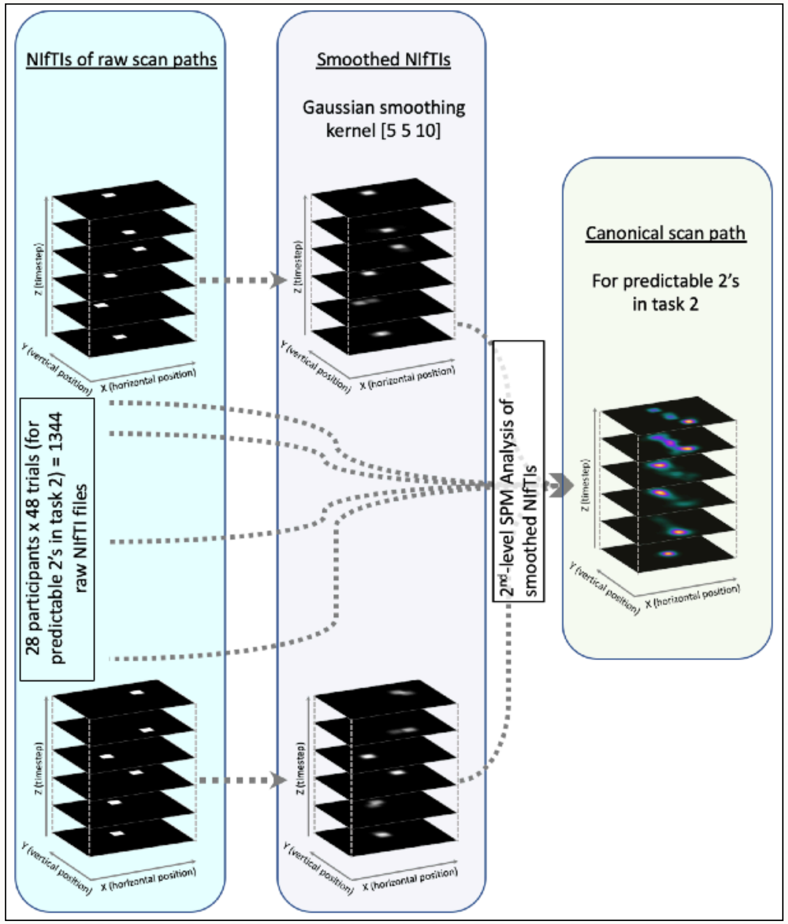
Task 3: Task 3 - video

Procedure & Matlab scripts may be found here:
github.com/jonathanmonney/MSC_ActInf/tree/master/01-Paradigm



Cullen & Monney (2020), *In Prep.*

DATA ANALYSIS:



To visualise and analyse the eye-tracking data, I used conventional fMRI analysis pipelines, by converting the data to 4D NIfTI format.

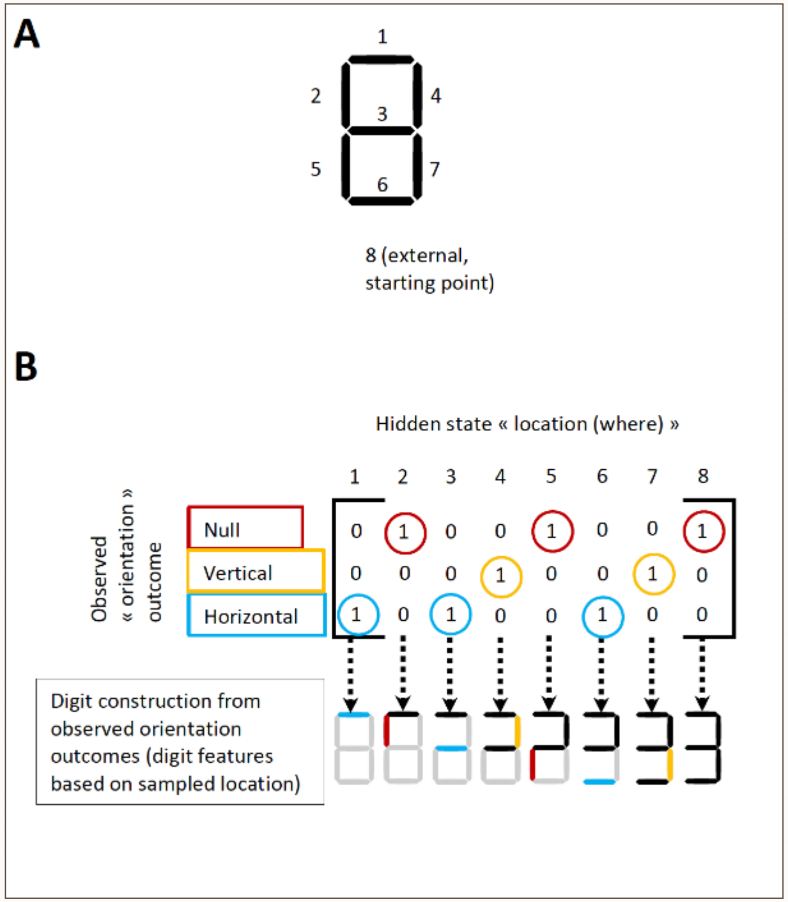
Following this, canonical scan paths were extrapolated. Using standard neuroimaging pre-processing techniques in SPM (realignment, trimming and smoothing), a second-level analysis was performed to infer statistical significance in saccading behaviour.

Data analysis & Matlab scripts may be found here:
github.com/jonathanmonney/MSC_ActInf/tree/master/02-Analysis

COMPUTATIONAL MODEL (MARKOV DECISION PROCESS):

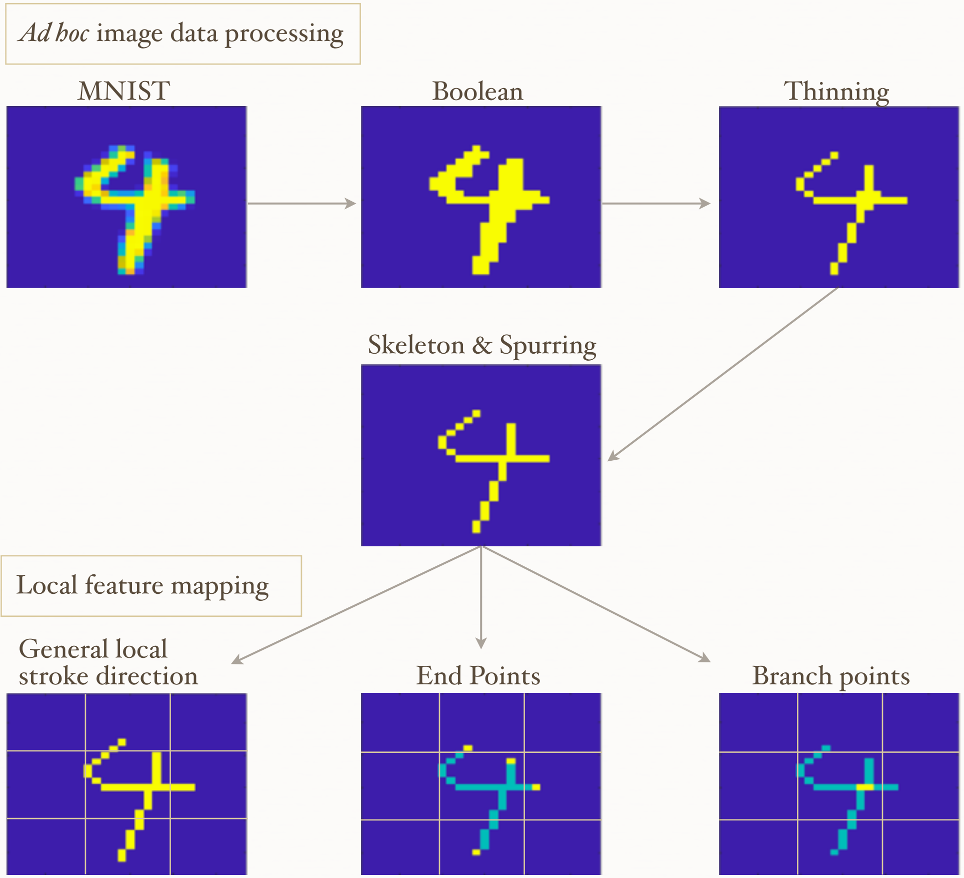
An initial MDP model was developed to identify «calculator-like» digits.

After training the model to create expectations, I asked it to make a decision with a limited number of «saccades». A likelihood matrix matching location with observation was used to generate prediction maps for the model.



Cullen & Monney (2020), *In Prep.*

Once the model was able to predict the calculator digits with 100% accuracy, I tested it on the MNIST dataset. The limited number of saccades is set to avoid full scene exploration and to force the model to make a decision based on its updated beliefs, thereby matching the experimental conditions from the paradigm. Due to marginally-above-chance performance on the MNIST digits, I trained the model to spatially learn 3 specific features. Some image data processing was required (thereby inferring our visual cortex proceeds through these steps in higher cortical regions for scene identification).



BIG BRIGHT BRAIN (BBB)

BBB YouTube Channel Co-creator, Project Manager, Scientific Writer & Compositor

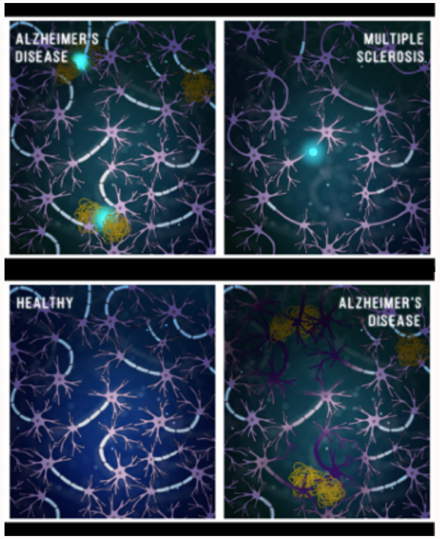
A group of colleagues from the IoPPN at King's College London and I decided to create a YouTube channel to promote recently published Neuroscience research.

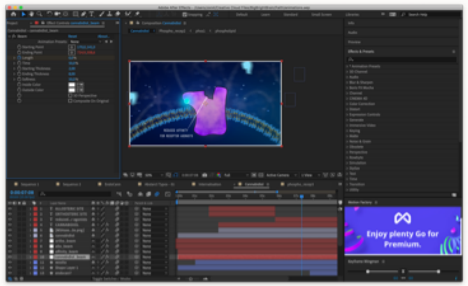
The aim was to expand scientific communication and to increase global interest for current neuroscience research by having the primary researchers talk about their projects.

When possible I added animation and infographics for enhanced scientific visual communication.

❖ **Filming, editing and compositing the channel intro sequence for the channel's videos**

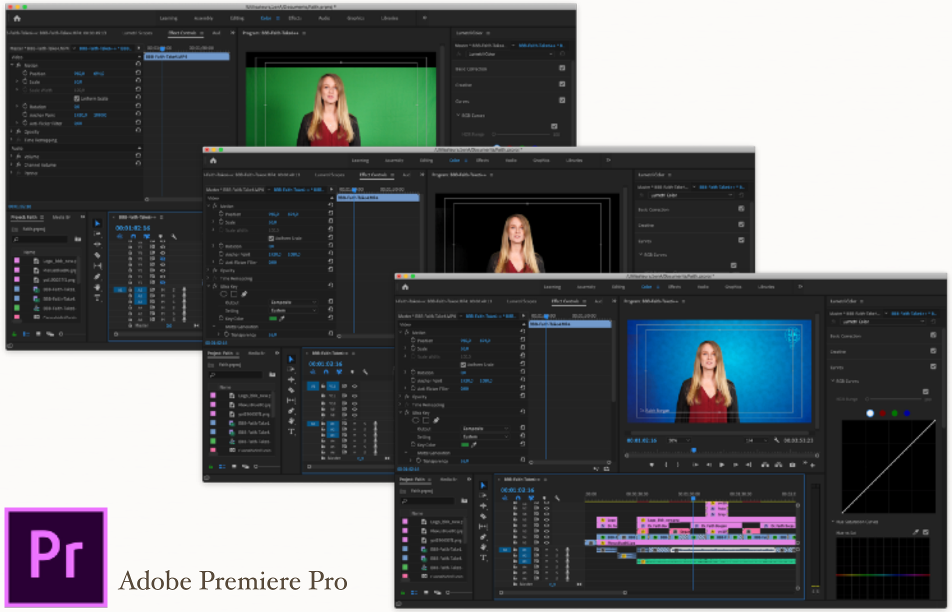
❖ **Logo design & animation/infographic creation and integration**





Adobe After Effects

❖ **Editing and compositing the videos**



Adobe Premiere Pro

BIG BRIGHT BRAIN

youtube.com/channel/UCaRmjmo7Mjo9uoLj4cR11_Q