# Samuel **Davenport**


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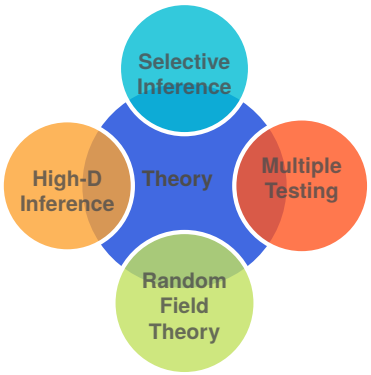
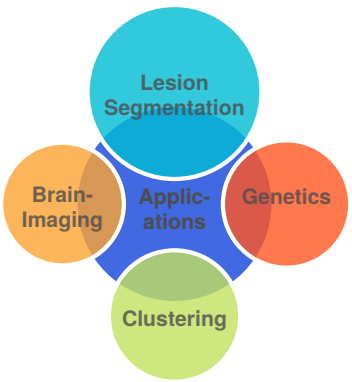
## Born
24/03/1994

## Citizenship
British and German

## Research Interests




## Work

2021-Present **University of California San Diego - Research fellow**
Working on developing statistical and machine learning methods for analyzing big data. Current projects include, 1) Developing conformal confidence sets for the results of image segmentation using convolutional neural networks. 2) Developing methods for performing fast resamping in very large datasets. 3) Creating new multiple testing approaches to analyse fMRI and MS lesion data which increase the accuracy of inference. 4) Developing non-parametric techniques for performing testing after transforming heavy tailed data. 5) Developing statistical inference for heritability estimation in genetics. 6) Creating confidence regions for density level sets in order to provide inference for density-based clustering. I am currently co-supervising 3 PhD students who are working on statistical methods in brain imaging.

2021 **University of Toulouse - Postdoctoral research fellow**
Worked with Professors Pierre Neuvial and Bertrand Thirion on post-hoc selection in multi-dimensional linear models with applications to brain imaging and transcriptomics.

2020-2021 **University of Oxford - Postdoctoral research fellow**
Worked with Professor Thomas E. Nichols on statistical inference using Random Field Theory and resampling methods.

## Education

2016-2020 **University of Oxford - DPhil in Statistics on the OxWaSP program**
Supervised by Professors Thomas E. Nichols and Chris Holmes. During the PhD I worked on developing statistical methods for image analysis with applications in Neuroimaging. Focused on Multiple Testing and Selective Inference.

2012-2016 **University of Cambridge - BA and Masters in Mathematics**
Distinction, coming 20th in the year out of 240 students and 1st in my college. Thesis on Network Changepoint Detection in fMRI data.
Courses included: Statistics for Machine Learning, Causal Inference, Probability and Measure Theory, Convolutional Neural Networks, Sampling and Experimental Design, the theory of Stochastic processes and BioStatistics.

2010-2012 **IB (International Baccalaureate) Diploma: 43/45 points**
Higher Level Mathematics, Physics and Chemistry all 7 (highest mark).

## Reviewing

**Neuroimage (6 articles), Imaging-Neuroscience, Journal of Computational and Graphical Statistics, Electronic Journal of Statistics, Human Brain Mapping, Psychometrika, Statistical Methods and Applications, Biometrics and Frontiers in Neuroscience**
I have been a reviewer for these journals and in this capacity have reviewed a number of articles relating to multiple testing, statistics in neuroimaging and Random Field Theory.

# Research

**Samuel Davenport**. Conformal confidence sets for biomedical image segmentation, in submission at ICLR 2025.

Amitay Eldar, Keren Mor Waknin, **Samuel Davenport**, Tamir Bendory, Armin Schwartzman, Yoel Shkolnisky. Object detection under the linear subspace model with application to cryo-EM images, arxiv, 2024.

Riccardo De Santis, Jelle J. Goeman, **Samuel Davenport**, Jesse Hemerik and Livio Finos. Permutation-based multiple testing when fitting many generalized linear models, arxiv, 2024.

**Samuel Davenport**, Armin Schwartzman, Thomas E. Nichols and Fabian JE Telschow. Riding the SuRF to Continuous Land - Part 2: Precise FWER control in Neuroimaging using Random Field Theory, 2023. In submission at JRSSC.

Fabian JE Telschow and **Samuel Davenport**. Riding the SuRF to Continuous Land - Part 1: Precise FWER Control for Gaussian related random fields, 2023. In submission at JASA.

**Samuel Davenport**, Bertrand Thirion and Pierre Neuvial. FDP control in multivariate linear models using the bootstrap, 2023. 2nd round of reviews at the Electonic Journal of Statistics.

**Samuel Davenport**, Thomas E. Nichols and Armin Schwartzman. Confidence regions for the location of peaks of smooth random fields, 2023. In submission at JMVA.

**Samuel Davenport** and Fabian JE Telschow. A comment on the finiteness of the second moment of the number of critical points of Gaussian random fields, 2022.

Fabian Telschow, **Samuel Davenport** and Armin Schwartzman. Functional delta residuals and applications to functional effect sizes, JMVA, 2022.

**Samuel Davenport**. Statistical Inference in fMRI using Random Field Theory and Resampling Methods, PhD Thesis, 2021.

**Samuel Davenport** and Thomas E. Nichols. The expected behaviour of random fields in high dimensions: contradictions in the results of Bansal and Peterson (2018), Magnetic Resonance Imaging, 2021.

**Samuel Davenport** and Thomas E. Nichols. Selective peak inference: Unbiased estimation of raw and standardized effect size at local maxima, NeuroImage, 2020.

# Acknowledged in

Blain et al 2022,Bowring et al 2019,Afyouni et al 2019,Teleschow and Schwartzman 2019,Sommerfield et al 2018

# Skills

**Spoken Languages:** Native English speaker, Good Italian and Intermediate French.

**Computer Languages:** Very experienced in using Matlab, Python and R to perform statistical analysis of large datasets. Proficient in Git, TensorFlow, Pytorch, LaTeX Linux and SQL. Extensive experience with parallel computing and the use of high performance computing clusters.

**Statistics:** Very experienced in the statistical analysis of large datasets, statistical hypothesis testing, multiple comparisons (with applications to brain imaging, genetics, running A/B tests), uncertainty quantification for neural networks, resampling methods in big data using multiplier bootstrap and permutation approaches for linear and generalized linear models, theory of multidimensional processes, random field theory, extreme value theory, dealing with non-Gaussian data and performing hypothesis testing after transforming data, visualizing statistics and imaging data.

**Machine Learning:** Experienced in training and testing deep neural networks for image segmentation and classication, conformal inference and risk control with a focus on segmentation of polyps tumors, melanoma and brain images. Experienced with using Large Language models both programmatically via Hugging face with research applications focusing on uncertainty quantitification and AI content detection and as a tool to increase productivity. Experienced with clustering large datasets and with providing post-hoc inference for selected clusters.

**Medical Imaging**: Extensive experience with processing and analyzing medical imaging datasets. Deep understanding of processing pipelines for resting state and task fMRI, morphometry and binary lesion images and both volume and surface data. Experienced with the use of neural networks for medical imaging data in 2D and 3D.

# Software

I have created and maintain a number of freely available software packages:

**StatBrainz:** The Statbrainz package contains Matlab code to perform statistical inference and visualization of brain imaging data. This includes functions to perform resampling and multiple testing. In particular methods for clustersize inference (including associated TDP bounds), and both single and simultaneous CoPE (coverage of probability sets) are provided. The package also provide code for reading and visualizing volumetric and surface brain imaging data.

**pyperm:** This package contains python code to perform inference in high-dimensional linear and generalized linear models using permutation and the bootstrap. In particular it provides post-hoc inference for multiple testing methods when considering multiple contrasts with simultaneous control of the false discovery proportion over all subsets of hypotheses.

**RFTtoolbox:** The RFTtoolbox contains Matlab code to perform voxelwise RFT analysis, LKC estimation, generation of convolution fields, perform Gaussizianization to improve Gaussianity, provide confidence regions for the location of peaks of random fields and many other features. These can be used to perform multiple testing and general study of multi-dimensional imaging data. Tutorials exploring these features are provided.

## Research Visits

11/23-11/23 **University of Padova**
I spent a week in Padova visiting Professor Livio Finos to discuss our work on developing permutation models for logistic regression of MS lesion data.

06/23-06/23 **University of Toulouse**
I went to Toulouse to visit Professor Pierre Neuvial to work on non-parametric TDP interference.

10/19-10/19 **KAUST - King Abdul Salman University of Science and Technology**
I went to Saudi Arabia to visit Professor Hernando Ombao and give a talk on clustersize inference using Random Field Theory.

07/19-08/19 **Technion - Israel Institute of Technology**
I visited Dr. David Azriel in Haifa, Israel to work on convolution random fields and peak detection with Drs. Fabian Telschow and Armin Schwarzman.

01/19-03/19 **University of California San Diego**
I spent 2 months working with Professor Schwarzman at UCSD on developing confidence regions for the locations of peaks in a random field.

## Internships

07/16-08/16 **Mercedes and the University of Cambridge**
I worked with the Mercedes Racing Team fitting mixed effects models to help understand tyre degradation.

06/15-07/15 **STATSLAB - Department of Statistics at the University of Cambridge**
I worked with Professor Chris Rogers on a project that involved analyzing the distribution of financial time series and backtesting statistical trading strategies.

06/14-08/14 **STATSLAB - Department of Statistics at the University of Cambridge**
I worked with Professor Nathanael Berestycki on analysis of the adjacent transposition shuffle.

## Awards

2016 **King's College Cambridge - Part III Mathematics Prize**

2011 **Silver Medal - British Mathematics Olympiad**
Came 29th out of around 1100 participants.

## Other Interests

I dance Lindy Hop and Boogie woogie competitively and play squash, tennis and ultimate frisbee.