Jesse Geerts

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Education

PhD Systems & Theoretical Neuroscience	*2016 - Present*
Sainsbury Wellcome Centre, University College London (UCL)	*London, UK*
Supervised by Prof Neil Burgess	

MSc Brain and Mind Sciences	*2014 - 2016*
UCL / Ecole Normale Supérieure / Sorbonne Université	*London, UK / Paris, FR*

BSc Natural Sciences	
BSc Neuroscience	*2010 - 2014*
University of Amsterdam	*Amsterdam, NL*

Research Experience

Sainsbury Wellcome Centre / UCL — 2017 - Present
PhD Candidate, supervised by Prof Neil Burgess — *London, UK*

Topic: Reinforcement Learning (RL) and planning algorithms employed by the brain, notably hippocampus

- Developed a Bayesian version of an RL strategy supporting planning and generalisation known as the Successor Representation

- Built a model of arbitration between multiple RL systems explaining navigation and decision making

- Worked on a model of trajectory-dependent firing in hippocampus

Gatsby Computational Neuroscience Unit / UCL — 2017
Rotation student, supervised by Prof Maneesh Sahani — *London, UK*

I worked on continual learning in Bayesian Neural Networks. By fixing weights with low variance, the goal was to avoid catastrophic forgetting when learning multiple tasks.

Sainsbury Wellcome Centre / UCL — 2017
Rotation student, supervised by Dr Adam Kampff — *London, UK*

I worked on electrophysiological recordings using probes with a high density of recording sites and analysed how this density affected spike sorting quality.

Institut du Cerveau et de la Moelle Epinière / Brain and Spine Institute — 2016
Research Intern, supervised by Dr Jean Daunizeau — *Paris, FR*

I built on a network model and analysed fMRI data of neurological patients that suffered from motor problems.

Theoretical Neurobiology Group / Wellcome Trust Centre for Neuroimaging — 2015
Masters Student, supervised by Dr Dimitris Pinotsis — *London, UK*

This project focussed on laminar differences in cortical local field potential. I co-developed a model for estimating causal effects across cortical layers.

Department of Brain and Cognition / University of Amsterdam — 2014
Undergraduate Student Intern, supervised by Dr Simon van Gaal — *Amsterdam, NL*

I analysed behaviour and EEG of subjects that performed a subconscious cognitive control task.

Talks and Posters

- July 2020. – <u>Jesse Geerts</u>, Kimberly Stachenfeld, Neil Burgess
  Uncertainty and the hippocampal predictive map.
  Invited talk at Gershman lab, Harvard University

- June 2020. – <u>Jesse Geerts</u>, Kimberly Stachenfeld, Neil Burgess
  Learning distributed Successor Representations using Kalman Filters.
  Invited talk at NeuroAI reading group, Mila Montreal

- April 2020. – <u>Jesse Geerts</u>, Kimberly Stachenfeld, Neil Burgess
  Probabilistic Successor Features allow for flexible behaviour.
  Spotlight Presentation at ICLR

- March 2020 – <u>Jesse Geerts</u>, Kimberly Stachenfeld, Neil Burgess
  Probabilistic Successor Representations allow for flexible behaviour.
  Poster at Cosyne, Denver, CO

- January 2020 – <u>Jesse Geerts</u>, Kimberly Stachenfeld, Neil Burgess
  A probabilistic approach to learning Successor Representations.
  Invited talk at Behrens lab, UCL / University of Oxford

- September 2019 – <u>Jesse Geerts</u>, Kimberly Stachenfeld, Neil Burgess
  Probabilistic Successor Representations with Kalman Temporal Differences.
  Poster at CCN, Berlin, Germany

- July 2019 – <u>Jesse Geerts</u>, Kimberly Stachenfeld, Neil Burgess
  Value, Prediction and Uncertainty in Hippocampus and Striatum.
  Talk at BCCN UCL Navigation Workshop, Tutzing, Germany

- March 2019 – <u>Jesse Geerts</u>, Fabian Chersi, Kimberly Stachenfeld, Neil Burgess
  Modelling hippocampal and dorsolateral striatal contributions to learning across domains.
  Talk at Cosyne Workshop, Lisbon, Portugal

- January 2019 – <u>Jesse Geerts</u>, Kimberly Stachenfeld, Neil Burgess
  Using Splitter Cell Representations for Reinforcement Learning.
  Talk at DeepMind Experimental Neuroscience Meeting, London, UK

- November 2018 – Kimberly Stachenfeld, <u>Jesse Geerts</u>, Neil Burgess, Timothy Behrens, Matthew Botvinick, Sam Gershman
  Representation learning for exploration and generalization in RL.
  Talk at SfN 2018 Nanosymposium, San Diego, CA, USA

- June 2018 – <u>Jesse Geerts</u>, Fabian Chersi, Kimberly Stachenfeld, Neil Burgess
  Modelling hippocampal and striatal contributions to reward-based navigation.
  Poster at iNav Symposium, Mont Tremblant, QC, Canada

- June 2018 – <u>Jesse Geerts</u>, Kimberly Stachenfeld, Neil Burgess
  Splitter cells and hierarchical reinforcement learning.
  Talk at Data Club, Sainsbury Wellcome Centre, London, UK

Publications

<u>Jesse P. Geerts</u>, Kimberly L. Stachenfeld, Neil Burgess. (2019). **Probabilistic Successor Representations with Kalman Temporal Differences**. *Cognitive Computational Neuroscience.* [DOI]

George Dimitriadis, Joana P. Neto . . ., <u>Jesse P. Geerts</u>, . . . Adam R. Kampff. (2018). **Why not record from every channel with a CMOS scanning probe?**. *BioRxiv.* [DOI]

Matthew G. Phillips, Stephen C. Lenzi, Jesse P. Geerts. (2018). **Cortical predictive mechanisms of auditory response attenuation to self-generated sounds**. *Journal of Neuroscience*, 37(22). [DOI]

Dimitris A. Pinotsis, Jesse P. Geerts, Lucas Pinto, Thomas H.B. Fitzgerald, Vladimir Litvak, Ryszard Auksztulewicz, Karl J. Friston. (2017). **Linking canonical microcircuits and neuronal activity: Dynamic causal modelling of laminar recordings**. *NeuroImage.* [DOI]

Jun Jiang, Camille M. Correa, Jesse P. Geerts, Simon van Gaal. (2018). **The relationship between conflict awareness and behavioral and oscillatory signatures of immediate and delayed cognitive control**. *NeuroImage*, 177, 11–19. [DOI]

Teaching & Supervision

PhD rotation Supervisor / UCL *2019 - Present*
I supervise a PhD rotation student on a project on recurrent neural circuits for reinforcement learning.

Teaching Assistant / PyStarters / SWC, UCL *2017 - Present*
Pythonic programming course for students and postdocs at the SWC and Gatsby Unit. Course website

Teaching Assistant / Systems & Theoretical Neuroscience / SWC & GCNU *2017*
Taught by SWC and Gatsby Unit faculty. Course website

Teaching Assistant / Statistics in R / University of Amsterdam *2013 - 2014*

Teaching Assistant / Mathematics for Neuroscience / University of Amsterdam *2014*

Skills

Programming Languages	Python, R, Matlab, JavaScript, LaTeX
Tools	TensorFlow, Cython, scikit-learn
Data Analysis Experience	Eletrophysiology, Behaviour, fMRI, EEG
Languages	English, Dutch, French, German

Awards

- 2016 – **Sainsbury Wellcome PhD Grant** Gatsby Charitable Foundation & The Wellcome Trust, UK

- 2015 – **Descartes Excellence Scholarship** French embassy in The Hague, NL

- 2015 – **Winter School Grant** Berlin School of Mind and Brain, DE

- 2013 – **2nd Place Undergraduate Project Prize** Natural Sciences, University of Amsterdam, NL

Volunteering & Outreach

The Dutch Review of Books (de Nederlandse Boekengids) / Amsterdam, NL *2019 - Present*
I write about neuroscience and machine intelligence for a national review magazine in the Netherlands.
Magazine website

Committee Member / Systems Seminars Series / SWC, London, UK *2017 - Present*
I co-organise an annual student-led symposium open to all neuroscientists in London. This year's symposium is about abstraction & generalisation.
Event website

Public Engagement Network / SWC, London, UK *2017 - Present*
As part of the Public Engagement Network, I have participated in projects presenting neuroscience and the SWC to school children and the wider public.
Project website

Teaching at BrainCamp / Instituti Atomi, Pristina, Kosovo   *2018*
I took part in a volunteering project teaching introductory neuroscience to gifted young students in Kosovo.
Project website

Presenter / New Scientist Live Festival, London, UK   *2017, 2018*
I represented the Sainsbury Wellcome Centre at the New Scientist's yearly festival, interacting with a wider audience to make neuroscience more accessible.
Event website

Committee Member / BetaBreak, Amsterdam, NL   *2011 - 2014*
I co-organised lunch-time events and discussions at the University of Amsterdam.
Organisation website