

## CV : ALEXIS DUBREUIL

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Personal: Born 24th of February 1986, French, 2 children  
Languages: French, English, Italian

### EDUCATION

2014 **PhD in Theoretical Neurosciences, Paris Descartes University, Paris, France**

*(supervisor: Nicolas Brunel ; examiners: Peter Latham, Alessandro Treves)*

Title of the thesis: 'Memory and Cortical Connectivity'.

2007-2011 **Ecole Normale Supérieure de Cachan, Physics Department, Cachan, France**

2007- Bachelor in Physics.

2011- Master « Theoretical Physics of Complex Systems » (Paris 6, 7, 11 and ENS Cachan).

2004-2007 **Classe Préparatoire aux Grandes Ecoles, MPSI-PSI, Clermont-Ferrand, France**

Intensive study of Mathematics and Physics.

#### Others: Machine learning classes

2018 Deep-learning-do-it-yourself, master level deep-learning course at ENS.

2015 L'apprentissage profond, series of lectures by Yan LeCun at Collège de France.

2013 Summer school: Statistical Physics, Optimization, Inference, and Message-Passing Algorithms, in Les Houches.

### RESEARCH EXPERIENCE

02/2018-present **Group for Neural Theory, Ecole Normale Supérieure, Paris**

*(post-doc, supervisor: Srdjan Ostojic)*

I am training machine learning tools (Recurrent Neural Networks) on various tasks and I use mathematical analysis to describe their dynamical properties and understand the cognitive processes they implement [7,8].

10/2016-10/2017 **Laboratory of Theoretical Physics, Ecole Normale Supérieure, Paris**

*(1 year, post-doc, supervisors: Rémi Monasson and Alessandro Treves)*

I have worked on a project entitled "Analogue computations underlying language mechanisms". I have used statistical physics tools and numerical simulations to investigate the properties of neural codes involved in representing continuous manifolds of objects [5,9].

10/2014-09/2016 **Laboratory of Theoretical Physics, Ecole Normale Supérieure, Jean Perrin Laboratory, Université Pierre et Marie Curie, Paris, France**

*(2 years, post-doc, supervisors: Rémi Monasson and Georges Debrégeas)*

I have analyzed large calcium imaging datasets (50,000 neurons recorded simultaneously) recorded in behaving animals (zebra-fish larvae). I have used numerical and dynamical system tools to understand how processes of sensory-motor transformations can be implemented in biological neural networks [3,4].

01/2013-08/2014 **Departments of Statistics and Neurobiology, University of Chicago, USA**

*(1 year 6 months, PhD student, supervisor: Nicolas Brunel)*

I have analyzed large-scale cortical connectivity measurements and compare them with connectivity properties of network models of memory [2,11,12].

09/2011-12/2012 **Neurophysics and Physiology Laboratory, Paris Descartes University, Paris, France**

*(1 year 6 months, PhD student, supervisor: Nicolas Brunel)*

I have studied the memory properties of various kinds of neural networks, focusing on their synaptic properties, for instance studying slow and fast learning networks [1,10].

04/2009-08/2010 **OEB Department, Harvard University, USA**

*(1 year 4 months, intern, supervisors: Yoram Burak and Bence P. Ölveczky)*

I have analyzed single-cell recordings in behaving animals (singing zebra-finch) and modeled these data to understand the biological processes underlying learning of motor sequences [13].

## TEACHING

2010 Harvard University: TA for the course “Computational Neuroscience” (30h).

2011 and 2012 Université Paris Descartes : TA in physics for first year medical students: fluid mechanics, electromagnetism, diffusion (80h).

2011 and 2012 Ecole Normale Supérieure : TA for the course “Advanced Course in Theoretical Neuroscience” (Cogmaster, ENS/EHESS/P5) (40h).

2016 Paris Descartes University: Course of Computational Neuroscience for L3 undergraduate students majoring in mathematics or computer science (25h).

## PUBLICATIONS

[1] “Memory capacity of networks with stochastic binary synapses”  
**A.M.Dubreuil**, Y.Amit, N.Brunel, PLoS Computational Biology, 2014.

[2] “Storing structured sparse memories in a large-scale multi-modular cortical network model”  
**A.M.Dubreuil**, N.Brunel, Journal of Computational Neuroscience, 2016.

[3] “Rheotaxis of larval zebrafish: behavioral study of a multi-sensory process”  
R.Olive, S.Wolf, **A.Dubreuil**, V.Bormuth, G.Debrégeas, R.Candelier, Frontiers in System Neuroscience, 2016.

[4] “A sensori-motor hub driving phototaxis in zebrafish”  
S.Wolf\*, **A.M.Dubreuil\***, T.Bertoni, U.Lucas Böhm, V.Bormuth, R.Candelier, S.Karpenko, D.G.C. Hildebrand, I.Bianco, R.Monasson, G.Debrégeas, Nature Communications 2017.  
\* equal contributions

## PIPELINE

[5] “Encoding of multiple spaces in grid-cell networks”  
A.M.Dubreuil\*, D. Spalla\*, R.Monasson, A. Treves, submitted to PNAS.

[6] “Short-term memory properties of sensory neural architectures”  
A.M.Dubreuil, submitted to Journal of Computational Neuroscience.

## CONFERENCE PROCEEDINGS

[7] “Minimal-dimensionality implementation of behavioral tasks in recurrent networks”  
A.M.Dubreuil, F.Mastrogiuseppe, S.Ostojic, COSYNE meeting 2019.  
**Travel grant awarded to the 20 abstracts with highest scores out of >1000 submissions**

[8] “Reverse-engineering recurrent neural networks via low-rank approximations”  
A.M.Dubreuil, S.Ostojic, Bernstein Conference 2018.

[9] “Encoding of multiple spaces in grid-cell networks”  
A.M.Dubreuil, R.Monasson, A.Treves, CNS meeting 2017.

[10] “Memory capacity of networks with stochastic binary synapses”  
A.M.Dubreuil, Y.Amit, N.Brunel, CNS meeting 2013.

[11] “Storing structured sparse memories in a large-scale multi-modular cortical network model”  
A.M.Dubreuil, N.Brunel, COSYNE meeting 2013.

[12] “Binary connectivity matrices storing complex memories in a multi-modular network”  
A.M.Dubreuil, N.Brunel, FENS workshop 2012 : “Dynamics of memory : what’s the evidence”.

[13] “Neural mechanisms underlying reduction in behavioral variability during trial-and-error learning”  
A.M.Dubreuil, Y.Burak, B.P.Ólveczky, COSYNE meeting 2010.

## **SELECTED TALK IN INTERNATIONAL CONFERENCE**

“A sensori-motor hub driving phototaxis in zebrafish”, September 2017, Neural Coding, Computation and Dynamics, Capbreton, France.

## **INVITED SEMINARS**

“A sensori-motor hub driving phototaxis in zebrafish”, June 2017, Bernstein Center for Computational Neuroscience, Berlin, Germany.

“A sensori-motor hub driving phototaxis in zebrafish”, May 2017, Group for cortical dynamics, IDIBAPS, Barcelona, Spain.

“Modeling networks of head-direction cells with non-linear dendritic interactions”, January 2017, IBENS, ENS, Paris, France.

“Shaping effective connectivity via non-linear dendritic interactions allows precise network control”, December 2016, MNEMOSYNE, INRIA, Bordeaux, France.

“Memory and cortical connectivity”, June 2014, Unité de Neurosciences Information et Complexité, Gif-sur-Yvette, France.

“Neural mechanisms underlying the reduction in behavioral variability during trial-and-error learning”, May 2010, Laboratory of Neurophysics and Physiology, Paris Descartes University, Paris, France.

## **REVIEWING ACTIVITIES**

Organization for Computational Neuroscience, Physical Review Letter, Physical review E

## **COMPUTER SCIENCE SKILLS**

programming: Python, Matlab, Keras, Pytorch, Fortran, Mathematica  
others: UNIX, Latex, Adobe Illustrator