

Ritwik K. Niyogi

Sir Henry Wellcome Postdoctoral Fellow
University of Oxford

Department of Experimental Psychology
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Education:

Gatsby Computational Neuroscience Unit, University College London, London, United Kingdom
PhD in Theoretical Neuroscience and Machine Learning: October, 2009-June, 2014.

Okinawa Computational Neuroscience Course (OCNC), Okinawa, Japan. June, 2012
RIKEN Brain Science Institute Summer Program: Neural Circuits from Top to Bottom, Saitama, Japan, July, 2013

Dickinson College, Carlisle, Pennsylvania, USA.
Bachelor of Science, *Summa Cum Laude*, August, 2005-May, 2009.
Majors: **Mathematics, Physics, Neuroscience**. Graduated with **Honors** in all three majors.

Stanford University Summer Session, 2007, Stanford, California, USA.

Research Experience

- Sir Henry Wellcome Postdoctoral Fellow
October 2018-Present
- Department of Experimental Psychology
University of Oxford
Oxford, UK**

Supervisor: **Dr. Mark Walton**

- Specific neural circuits and neuromodulation underlying real-time cost-benefit decision-making
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- Sir Henry Wellcome Postdoctoral Fellow
November 2017-September 2018
- Department of Psychiatry, UNC Neuroscience Center
University of North Carolina at Chapel Hill,
Chapel Hill, NC, USA**

Supervisor: **Prof Garret Stuber**

- Specific neural circuits underlying reward learning; real-time cost-benefit decision-making
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- Postdoctoral Fellow
October 2014-October 2017
- Department of Neuroscience & Brain Science Institute
Johns Hopkins University School of Medicine,
Baltimore, MD, USA**

Supervisor: **Prof Jeremiah Cohen**

- Specific neural circuits and neuromodulation underlying real-time cost-benefit decision-making, and learning under uncertainty
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- PhD Student
April 2010-October 2014
- Gatsby Computational Neuroscience Unit
University College London, London, UK**

Adviser/Supervisor: **Prof Peter Dayan** (Gatsby Computational Neuroscience Unit).

- Decision-making and learning, neuroeconomics, stochastic optimal control theory, reinforcement learning, computational neuromodulation

- **PhD Thesis:** *What to do, when to do it, how long to do it for: a normative, microscopic approach to the labour-leisure tradeoff.* Examiners: Dr. David Silver (UCL/ Google Deepmind) and Prof Matthew Botvinick (Princeton/ Google Deepmind)
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- Summer Research Assistant
June-August 2009
June-August 2008

**Neuroscience for Cognitive Control Laboratory
Center for the Study of Brain, Mind and Behavior
(CSBMB) Princeton University, Princeton, NJ, USA**

Advisers: **Prof Jonathan D. Cohen** (Psychology, Neuroscience) and **Prof Philip J. Holmes** (Program in Applied and Computational Mathematics, Mechanical and Aerospace Engineering).

- Investigating the source of sub-optimality in human decision-making in a simple Two-Alternative Forced Choice (TAFC) task. Supervisor: *Dr. Patrick Simen, Dr. Angela Yu, Prof Jonathan D. Cohen, Dr. Fuat Balci*
 - Mathematical analyses of Leaky Competing Accumulator (LCA) models. Supervisor: *Prof Philip J. Holmes.*
 - Investigating human performance in Deadlined decision making tasks. Supervisor: *Dr. Angela Yu, Prof Jonathan D. Cohen.*
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- Research Assistant
June-August 2007

**McClelland laboratory Center for Mind, Brain and Computation (MBC) Department of Psychology
Stanford University, Stanford, CA, USA**

Adviser/Supervisor: **Prof James L.(Jay) McClelland** (Psychology).

- Investigating the Neurodynamics of Decision Making
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- Research Assistant
June-August 2006
September 2006-January 2007 (offsite).

**Clinical Cognitive Neuroscience Laboratory
Western Psychiatric Institute and Clinic, University of Pittsburgh Medical Center, Pittsburgh, PA, USA**

Adviser/Supervisor: **Prof. Raymond Cho** (Psychiatry)

- Investigating the generalizability and task specificity of Cognitive Control in task-switching using Parallel Distributed Processing (PDP) models
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- Student Researcher
September 2005-December 2007

**Unconscious Semantic Cognition Laboratory
Department of Psychology
Dickinson College, Carlisle, PA, USA**

Supervisor/Adviser: **Prof Richard L. Abrams** (Psychology)

- Investigating Unconscious Cognition
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- Honors Researcher
August 2008-May 2009

**Non-Linear Lattice Dynamics Laboratory
Department of Physics
Dickinson College, Carlisle, PA, USA**

Adviser/Supervisor: **Prof Lars Q. English** (Physics).

- Thesis: *Synchronization and Hebbian Learning in a Network of Coupled Neural Phase Oscillators.*
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- Honors Researcher
August 2008-May 2009

Department of Mathematics
Dickinson College, Carlisle, PA, USA

Supervisor: **Dr. Kong-Fatt Wong-Lin** (Program in Applied and Computational Mathematics, Princeton University). Adviser: Prof John MacCormick (Computer Science).

- Thesis: *Dynamical Effects of Non-Linearities and Time-Varying Gain Modulation in Neurally Plausible Network Models of Perceptual Decision-Making Tasks.*
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- Honors Researcher
January-May 2009

Program in Neuroscience
Dickinson College, Carlisle, PA, USA

Supervisor: **Dr. Patrick Simen** (Program in Applied and Computational Mathematics, Princeton University).

Adviser: Prof Anthony Pires (Biology, Program in Neuroscience).

- Thesis: *The Source of Suboptimality in Human Performance on Two-Alternative Forced Choice Motion-Discrimination Decision-Making Tasks.*
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Fellowships

- **Sir Henry Wellcome Postdoctoral Fellowship, GBP 250,000.**
- Gatsby Research Studentship, 2009-2014, Gatsby Computational Neuroscience Unit.
- Galkin Undergraduate Summer Research Fellowship (2006), Brain Science Program, Brown University.

Honours and Awards

- **Best Talk Award, Society for Neuroeconomics, 2013**
- Faculty of Life Sciences award, UCL, 2013
- Brains for Brains Young Researchers' Computational Neuroscience Award, Bernstein Computational Neuroscience Association, 2010 (*award plus travel grant to visit computational neuroscience institutes in Germany*).
- Phi Beta Kappa (*PBK*), 2009.
- Summa Cum Laude, Dickinson College, 2009.
- Honors in Mathematics, Neuroscience and Physics, Dickinson College, 2009.
- Delaplaine McDaniel Prize, 2007 (*GPA dependent, awarded to a single member of the sophomore class*).
- Member of Pi Mu Epsilon (*IME*), the National Mathematics Honors Society.
- Member of Alpha Lambda Delta (*ALD*) – the National Freshman Honor Society (*GPA>3.5*).
- Invited for membership, Omicron Delta Kappa (*ODK*), Upsilon Circle, (*top 35% of class*).
- John Dickinson Scholarship—for excellence in Academics in High School and College.
- John Montgomery Scholarship—for excellence in Academics in College.
- Dean's List, Fall 2005-2008 (*GPA>3.7*).
- Carolyn Soward Student Researcher in Mathematics (August 2006-May 2009).

Manuscripts in preparation

- 1) **Niyogi, R.K.*** & Namboodiri, V.M.K.* *Reward rate modulates reward prediction in dopaminergic circuits*, in preparation.
- 2) **Niyogi, R.K.**, Solomon R.B, Breton Y-A, Conover, K., Shizgal, P. & Dayan, P. *The utility of leisure*, in preparation.
- 3) **Niyogi, R.K.** & Dayan, P. *Fatigue and satiation: implications for the labour-leisure tradeoff*, in preparation.

- 4) **Niyogi, R.K.**, Breton Y-A, Hernandez, G., Trujillo-Pisanty, I., Cossette, M.-P, Solomon R.B., Conover, K., Shizgal, P. & Dayan, P. *Costs or benefits: Disentangling the computational role of tonic dopamine using a normative, microscopic approach*, in preparation.
- 5) **Niyogi, R.K.**, Breton Y-A, Conover, K., Shizgal, P. & Dayan, P. *The value of information of value*, in preparation.

Peer Reviewed Journal Publications

- 1) Ahilan, S., Solomon, R., Breton Y-A, Conover, K., **Niyogi, R.K.**, Shizgal P., Dayan, P. *Forgetful inference in a sophisticated world model*, (under review)
- 2) **Niyogi, R.K.**, Shizgal, P. & Dayan, P. *Some work and some play: microscopic and macroscopic approaches to labor and leisure*, PLoS Computational Biology 10(12): e1003894 (2014)
- 3) **Niyogi, R.K.**, Breton Y-A, Solomon R.B, Conover, K., Shizgal, P. & Dayan, P. *Optimal indolence: how long to work and how long to play*, Journal of the Royal Society Interface, 11, 20130969 (2013)
- 4) **Niyogi, R.K.** & Wong-Lin, K-F, *Dynamic excitatory and inhibitory gain modulation can produce flexible, robust and optimal decision-making*, PLoS Computational Biology, 9(6):e1003099, (2013)
- 5) Balci, F., Simen, P., **Niyogi, R.**, Saxe, A., Hughes, J.A., Holmes, P., & Cohen, J.D. *Acquisition of decision making criteria: accuracy ultimately loses the competition with reward rate*, Attention Perception Psychophysics, **73(2)**, 640-657 (2011)
- 6) **Niyogi, R.K.** & English, L.Q. *Learning-rate-dependent clustering and self-development in a network of coupled phase oscillators*, Physics Review E, **80**, 066213 (2009)

Presentations at Conferences

- Bari, B.A., Grossman, C., **Niyogi, R.K.**, Cohen, J.Y. *Action-outcome encoding in dorsomedial prefrontal cortex*. Society for Neuroscience, Washington DC, 2017.
- Ahilan, S., Solomon, R., Conover, K., **Niyogi, R.K.**, Shizgal P., Dayan, P. *Observing the observer observing: forgetful world modelling in a self-stimulation task*. Reinforcement Learning and Decision Making (RLDM), 2017, Ann Arbor, MI; Computational and Systems Neuroscience (Cosyne), 2017, Salt Lake City, UT.
- Guez, A., **Niyogi, R.**, Bach, D., Dolan, R. & Dayan, P. *A normative theory of approach-avoidance conflicts during dynamic foraging in humans*. The 1st Multidisciplinary Conference on Reinforcement Learning and Decision Making (RLDM), 2013, Princeton, NJ.
- **Niyogi, R.K.**, Breton, Y.A, Solomon, R.B., Conover, K., Shizgal, P., & Dayan, P. *Some work and some play: a normative, microscopic approach to allocating time between work & leisure*. Computational and Systems Neuroscience (Cosyne), 2013, Salt Lake City, UT.
- **Niyogi, R.K.**, Breton, Y.A., Conover, K., Solomon, R.B., Shizgal, P., & Dayan, P. *Semi-Markov models of the molecular psychophysics of brain stimulation reward*. Computational and Systems Neuroscience (Cosyne), 2012, Salt Lake City, UT.
Also presented at Federation of European Neurosciences (FENS), 2012, Barcelona, Spain.

- **Niyogi, R.K.**, & Wong-Lin, K-F. *Time-varying gain modulation on neural circuit dynamics and performance in perceptual decisions*. Computational and Systems Neuroscience (Cosyne), 2010, Salt Lake City, UT.
- **Niyogi, R.**, & Wong-Lin, K-F. *Dynamical Effects of Non-Linearities and Time-Varying Gain Modulation in Neurally Plausible Network Models of Perceptual Decision-Making*. Sigma Xi Student Research Symposium, 2009, Saint Joseph's University, Philadelphia, PA.
- **Niyogi, R.**, & English, L.Q. *Synchronization and Hebbian Learning in a Network of Coupled Neural Phase Oscillators*. Sigma Xi Student Research Symposium, 2009, Saint Joseph's University, Philadelphia, PA.
- **Niyogi, R.**, Gleichgerricht, E., & Abrams, R.L. *How Smart is the Unconscious? Exploring the Limits of Unconscious Cognition through the Two-Word Challenge*. 4th Annual Undergraduate Science Research Symposium, 2007, Ursinus College, Collegeville, PA.
- Abrams, R.L., Stull, S., Rockman, L., **Niyogi, R.**, & Fisher, F. *Unconscious processing of visually masked words by second-and third-grade children*. Eastern Psychological Association (EPA) Conference, 2007, Philadelphia, PA.
- Abrams, R.L., Ilieva, I., Niblock, A., **Niyogi, R.**, & Shainheit, C. *Unconscious Semantic Priming in the Absence of Partial Awareness*. Eastern Psychological Association (EPA) Conference, 2006, Baltimore, MD. (This research was subsequently reported in the paper: Abrams, R.L., & Grinspan, J. (2007). Unconscious priming in the absence of partial awareness, *Consciousness and Cognition*, 16(4), 942-953; my contribution is acknowledged in an Authors' Note)

Talks

- Icahn School of Medicine at Mount Sinai, July 2018
- Brown University, July 2018
- Columbia University, September, 2017
- Janelia Research Campus, September, 2017
- University of North Carolina, Chapel Hill, September, 2017
- UCSF, July 2017
- Emotion Club, Wellcome Trust Centre for Neuroimaging, UCL, May 2014
- Brain Conference: Controlling Neurons, Circuits and Behaviour, Rungstedgaard, Denmark, April 2014
- Society for Neuroeconomics, Lausanne, Switzerland, September 2013 **[won Best Talk Award]**
- Gatsby Unit-Columbia University-Hebrew University Jerusalem Tri-Centre Meeting, June 2013.
- Princeton University, March 2013.
- Center for Neuroeconomics, NYU, March 2013.
- *Invited to speak at Computational and Systems Neuroscience (CoSyNe) 2014 workshop: Information sampling in behavioral optimization (Bruno Averbeck, Robert C. Wilson, Matthew R. Nassar organizers); declined owing to insufficient travel funds.*

Colloquia

- All College Senior Research Symposium: "Synchronization and Hebbian Learning in a Network of Coupled Neural Phase Oscillators", April, 2009, Dickinson College, PA.
- Math/CS Chat: "The Neurodynamics of Decision Making", November, 2007, Dickinson College, Carlisle, PA.
- Math/CS Chat: "Investigating Conflict Monitoring and Cognitive Control using Parallel Distributed Processing models", November, 2006, Dickinson College, Carlisle, PA.

Membership in Professional Organizations

- Member, Society for Neuroscience
- Member, Society for Neuroeconomics
- Student Member, Cognitive Science Society (2007).
- Associate Member, Eastern Psychological Association (2005-2009).
- Attended the Annual Meeting of the Sloan-Swartz Centers for Theoretical Neuroscience, Princeton, NJ, July, 2008.

Teaching Experience

Teaching Assistant, Theoretical Neuroscience, **Gatsby Unit**, **October-December 2010**

Teaching Assistant, Calculus I and II, **Dickinson College**, **January 2007-May 2009**.

Teaching Assistant, Workshop Physics-I, **Dickinson College**, **August 2006-December 2006**.

Mathematics Tutor, Calculus, **Dickinson College**, **August 2006-May 2009**.