

## Curriculum Vitae: A. B. Barrett

### Name

Adam Bruno Barrett, MA (Cantab), MMath (Cantab), DPhil (Oxon).

### Date of Birth

21st March 1981

### Nationality

British

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### Academic Posts

Oct 2018-: Postdoctoral Research Fellow, Data Intensive Science Centre, Department of Physics and Astronomy, University of Sussex, Brighton, UK. Funded by STFC; Principal Investigator Seb Oliver.

Oct 2013-Sep 2018: EPSRC Research Fellow, Sackler Centre for Consciousness Science and Department of Informatics, University of Sussex, Brighton, UK; part-time, 0.6 FTE.

Jan 2014-Aug 2014: Visiting Research Fellow, Department of Clinical Sciences, University of Milan, Italy (Massimini Lab).

Jun 2009- Sep 2013: Postdoctoral Research Fellow, Neurodynamics and Consciousness Laboratory (Anil Seth lab), Sackler Centre for Consciousness Science and Department of Informatics, University of Sussex, Brighton, UK; (EPSRC funding).

Mar 2007- Dec 2008: Postdoctoral Research Fellow, Institute for Adaptive and Neural Computation, School of Informatics, University of Edinburgh, UK. Funded by the Human Frontiers in Science Project; Principal Investigator Mark van Rossum (chief PI for the project was Richard Morris, Centre for Cognitive and Neural Systems, University of Edinburgh).

### University Education

2003-2006: University of Sussex (2003-4), Balliol College, University of Oxford (2004-2006), DPhil in Theoretical Physics (research area: string theory; supervisor: Andre Lukas; supported by PPARC research studentship; institutional move due to supervisor's move from Sussex to Oxford). Thesis entitled "M-theory on Manifolds with  $G_2$  Holonomy".

2002-2003: St John's College, University of Cambridge (Certificate of Advanced Study in Mathematics; Masters equivalent, MMath awarded retrospectively in 2011).

1999-2002: St John's College, University of Cambridge (Mathematical Tripos).

### University Degrees

DPhil, University of Oxford.

Cambridge University Mathematical Tripos Part III: MMath with Distinction.

Cambridge University Mathematical Tripos: BA/MA (Hons) 1<sup>st</sup> Class (Part IA 1<sup>st</sup> class; Part IB 1<sup>st</sup> class; Part II 1<sup>st</sup> class).

### Academic Publications

[Most significant publications denoted with an asterisk.]

43. Barrett, A.B., Mediano, P.A.M. (submitted). The Phi measure of integrated information is not well-defined for all physical systems.

42. Sherman, M.T., Seth, A.K., & Barrett, A.B. (2018). Quantifying metacognitive thresholds using signal-detection theory. *bioRxiv* 361543.

\* 41. Mediano, P.A.M., Seth, A.K., & Barrett, A.B. (2018). Measuring integrated information: Comparison of candidate measures in theory and simulation. *ArXiv* 1806.09373 [q-bio.NC].

40. Bor, D., Barrett, A.B., Schwartzman, D., & Seth, A.K. (2018). Response to Ruby et al: On a 'failed' attempt to manipulate conscious perception with transcranial magnetic stimulation to prefrontal cortex. *Consciousness and Cognition* 65: 334-341.
39. Barnett, L., Barrett, A.B., & Seth, A.K. (2018). Solved problems for Granger causality in neuroscience: A response to Stokes and Purdon. *Neuroimage* 178: 744-748.
38. Barnett, L., Barrett, A.B., & Seth, A.K. (2018). Misunderstandings regarding the application of Granger causality in neuroscience. *PNAS* 201714497.
- \* 37. Barrett, A.B. (2018). Stability of zero-growth economics analysed with a Minskyan model. *Ecol. Econ.* 146: 228-239.
36. Bola, M., Barrett, A.B., Pigorini, A., Nobili, L., Seth, A.K., & Marchewka A. (2018). Loss of consciousness is related to hyper-correlated gamma-band activity in anesthetized macaques and sleeping humans. *Neuroimage*. 167: 130-142.
35. Schartner, M.M., Carhart-Harris, R.L., Barrett, A.B., Seth, A.K., & Muthukumaraswamy, S.D. (2017). Increased spontaneous MEG signal diversity for psychoactive doses of ketamine, LSD and psilocybin. *Nat. Sci. Rep.* 7: 46421.
34. Bor, D., Schwartzman, D.J., Barrett, A.B., & Seth, A.K. (2017). Theta-burst transcranial magnetic stimulation to the prefrontal or parietal cortex does not impair metacognitive visual awareness. *PLoS ONE* 12(2): e0171793.
- \* 33. Schartner, M.M., Pigorini, A., Gibbs, S.A., Arnulfo, G., Sarasso, S., Barnett, L., Nobili, L., Massimini, M., Seth, A.K., & Barrett, A.B. (2017). Global and local complexity of intracranial EEG decreases during NREM sleep. *Neurosci. Conscious.* 3 (1): niw022.
32. Barrett, A.B. (2016). A comment on Tononi & Koch (2015) 'Consciousness: here, there and everywhere?'. *Phil. Trans. R. Soc. B* 20140198.
31. Schartner, M.M., Seth, A.K., Noirhomme, Q., Boly, M., Bruno, M.A., Laureys, S., & Barrett, A.B. (2015). Complexity of multi-dimensional spontaneous EEG decreases during propofol induced general anaesthesia. *PLoS ONE* 10(8): e0133532.
30. Sherman, M.T., Seth, A.K., Barrett, A.B., & Kanai, R. (2015). Prior expectations facilitate metacognition for perceptual decision. *Consciousness and Cognition* 35: 53-65.
- \* 29. Barrett, A.B. (2015). Exploration of synergistic and redundant information sharing in static and dynamical Gaussian systems. *Phys. Rev. E* 91: 052802.
28. Sherman, M.T., Barrett, A.B., & Kanai, R. (2015). Inferences about consciousness using subjective reports of confidence. In: *Overgaard, M. (ed.) Behavioral Methods in Consciousness Research*. Oxford University Press, Oxford, UK.
27. Seth, A.K., Barrett, A.B., & Barnett, L. (2015). Granger causality analysis in neuroscience and neuroimaging. *J. Neurosci.* 35(8): 3293-3297.
26. Garfinkel, S.N., Seth, A.K., Barrett, A.B., Suzuki, K., & Critchley, H.D. (2015). Knowing your own heart: Distinguishing interoceptive accuracy from interoceptive awareness. *Biological Psychology* 104: 65-74.
25. Barrett, A.B., & Seth, A.K. (2014). Directed spectral methods. In: *Jaeger, D. and Jung, R. (eds.) Encyclopedia of Computational Neuroscience*. Springer, New York.
24. Scott, R.B., Dienes, Z., Barrett, A.B., Bor, D., & Seth, A.K. (2014). Blind insight: metacognitive discrimination despite chance task performance. *Psych. Science* 25(12): 2199-2208.
23. Gould C., Froese T., Barrett A.B., Ward J. and Seth A.K. (2014). An extended case study on the phenomenology of sequence-space synaesthesia. *Front. Hum. Neurosci.* 8:433.
22. Vandenbroucke, A.R.E., Sligte, I.G., Barrett, A.B., Seth, A.K., Fahrenfort, J.J., & Lamme, V.A.F. (2014). Accurate metacognition for visual sensory memory representations. *Psych. Science* 25(4): 861-873.
- \* 21. Barrett, A.B. (2014). An integration of integrated information theory with fundamental physics. *Front. Psychol.* 5(63).
- \* 20. Barrett, A.B., Dienes, Z., & Seth, A.K. (2013). Measures of metacognition on signal-detection theoretic models. *Psych. Meth.* 18(4): 535-552.

19. Garfinkel, S.N., Barrett, A.B., Minati, L., Dolan, R.J., Seth, A.K. & Critchley, H.D. (2013). What the heart forgets: Cardiac timing influences memory for words and is modulated by metacognition and interoceptive sensitivity. *Psychophysiology* 50(6): 505-512.
18. Barrett, A.B., & Barnett, L. (2013). Granger causality is designed to measure effect, not mechanism. *Frontiers in Neuroinformatics* 7(6).
17. van Rossum, M.C.W., Shippi, M., & Barrett, A.B. (2012). Soft-bound synaptic plasticity outperforms hard-bound plasticity for a variety of learning paradigms. *PLoS Comput. Biol.* 8(12): e1002836.
16. Feldwisch-Drentrup, H., Barrett, A.B., Smith, M.T., & van Rossum, M.C.W. (2012). Fluctuations in the open time of synaptic channels: an application to noise analysis based on charge. *J. Neurosci. Meth.* 210(1): 15-21.
15. Barrett, A.B., Murphy, M., Bruno, M.A., Noirhomme, Q., Boly, M., Laureys, S., & Seth, A.K. (2012). Granger causality analysis of steady-state electroencephalographic signals during propofol-induced anaesthesia. *PLoS ONE*, 7(1): e29072.
14. Seth, A.K., Barrett, A.B., & Barnett, L. (2011). Causal density and information integration as measures of conscious level. *Phil. Trans. Roy. Soc. A*, 369:3748-3767.
13. Froese, T., Gould, C., & Barrett, A.B. (2011). Re-Viewing from Within: A commentary on the use of first- and second-person methods in the science of consciousness. *Constructivist Foundations*, 6(2): 254-269.
- \* 12. Barrett, A.B., & Seth, A.K. (2011). Practical measures of integrated information for time-series data. *PLoS Comput. Biol.*, 7(1): e1001052.
11. Seth, A.K., & Barrett, A.B. (2010). Neural theories need to account for, not discount, introspection and behaviour. *Cogn. Neurosci.*, 1(3): 227-228.
- \* 10. Barrett, A.B., Barnett, L., & Seth, A.K. (2010). Multivariate Granger causality and generalized variance. *Phys. Rev. E*, 81: 041907.
9. Cortes, J.M., Greve, A., Barrett, A.B., & van Rossum, M.C.W. (2010). Dynamics and robustness of familiarity memory. *Neural Comput.*, 22(2):448-466.
- \* 8. Barnett, L., Barrett, A.B., & Seth, A.K. (2009). Granger causality and transfer entropy are equivalent for Gaussian variables. *Phys. Rev. Lett.*, 103: 238701.
7. beim Graben, P., Barrett, A.B., & Atmanspacher, H. (2009). Stability criteria for the contextual emergence of macrostates in neural networks. *Network: Computation in Neural Systems*, 20(3): 177-195.
- \* 6. Barrett, A.B., Billings, G.O., Morris, R.G.M., & van Rossum, M.C.W. (2009). State based model of long-term potentiation and synaptic tagging and capture. *PLoS Comput. Biol.*, 5(1): e1000259.
- \* 5. Barrett, A.B., & van Rossum, M.C.W. (2008). Optimal learning rules for discrete synapses. *PLoS Comput. Biol.*, 4(11), e1000230.
4. Barrett, A.B., (2006). M-theory on Manifolds with G2 Holonomy. DPhil thesis, University of Oxford, UK.
- \* 3. Anderson, L.B., Barrett, A.B., Lukas, A., & Yamaguchi, M. (2006). Four-dimensional effective M-theory on a singular G2 manifold. *Phys. Rev. D*, 74, 086008. (Authors in alphabetical order; ABB was lead author; AL was senior author.)
2. Anderson, L.B., Barrett, A.B., & Lukas, A. (2006). M-theory on the orbifold C2/ZN. *Phys. Rev. D*, 73, 106011. (Authors in alphabetical order; ABB was lead author; AL was senior author.)
1. Barrett, A.B., & Lukas, A. (2005). Classification and moduli Kaehler potentials of G2 Manifolds. *Phys. Rev. D*, 71, 046004. (Authors in alphabetical order; ABB was lead author; AL was senior author.)

### Research funding awards

EPSRC Research Fellowship EP/L005131/1 “Explaining Consciousness as Neural Dynamical Complexity”, £326,765, 2013-2018.

Contributions to case-for-support for three funding bids to the Dr. Mortimer and Theresa Sackler Foundation, to fund the Sackler Centre for Consciousness Science at the University of Sussex (PIs Anil Seth and Hugo Critchley). These have together brought in approximately £5m from 2013-2021.

### **Editorial board member**

2013-: Frontiers in Consciousness Research

2013-17: Animal Behaviour and Cognition

### **Review work**

Reviewer for the following journals: Frontiers in Robotics and AI, Information, Trends in Neurosciences, Memory and Cognition, Anesthesiology, Frontiers in Computational Neuroscience, Nature Reviews Neuroscience, PeerJ, Physical Review Letters, Physical Review E, Brain and Cognition, Neuropsychiatric Disease and Treatment, Neuroscience of Consciousness, Nature Scientific Reports, Neural Networks, Complexity, Journal of Consciousness Studies, Frontiers in Neuroinformatics, Journal of Clinical Monitoring and Computing, Current Biology, Neurocomputing, Entropy, Neuroscience Letters, Frontiers in Human Neuroscience, Journal of Neuroscience Methods, Clinical EEG and Neuroscience, Biological Cybernetics, Cognitive Neuroscience, Automatica, PLoS ONE, Neural Systems and Circuits, Computational Intelligence and Neuroscience, Neural Computation, European Physics Letters, Consciousness and Cognition, Frontiers in Consciousness Research, Journal of Computational Neuroscience, PLoS Computational Biology, Bulletins of Mathematical Biology.

Reviewer also for the India Alliance, Mind Science Foundation, the Wellcome Trust, the Romanian National Research Council, The Springer Encyclopedia of Computational Neuroscience, and Scholarpedia.

### **Selected conference talks / seminars**

“Integrated information theory, complexity, conscious unity and disconnection”, invited talk at plenary symposium on “Conscious unity - how does a healthy brain create one conscious subject?”, Association for the Scientific Study of Consciousness, Krakow, Poland (2018).

“Perspectives on integrated information theory”, invited opening talk, colloquium on “The neural basis of unified consciousness”, Royal Netherlands Academy of Arts and Sciences, Amsterdam (2018).

“Can integrated information theory be integrated with fundamental physics?”, Conference on “What is consciousness and why observers matter in quantum theory”, Cambridge (2017).

“Stability of zero-growth economics analysed with a Minskyan model”,

- European Association for Evolutionary Political Economy Conference, Budapest, Hungary (2017).
- Association for Heterodox Economics Conference, Manchester, UK (2017)
- Nordic Post-Keynesian Conference, Aalborg, Denmark (2017).

“Measuring consciousness”,

- St Thomas’ Hospital, King’s College London (2017).
- Meeting of the South of England Neurosciences Association, Brighton (2017).

“Synergistic and redundant information sharing in Gaussian systems”,

- Invited talk at workshop “Quantitative Biomedicine for Health and Disease”, Basque Centre for Applied Mathematics, Bilbao, Spain (2015).
- Invited talk at workshop “Neural Information Dynamics, Causality and Computation”, Frankfurt Institute for Advanced Study, Germany (2014).

“Information integration, Granger causality and measuring conscious level”,

- University of Ghent, Belgium (2013).
  - Cognitive and Brain Sciences Unit, University of Cambridge (2013).
  - Knight Lab, University of California at Berkeley, USA (2012).
  - University of Geneva, Switzerland (2012).
- “How can we know when we know we know? Towards measuring metacognition”,  
Association for the Scientific Study of Consciousness, Brighton, UK (2012).
- “The Challenge of Measuring Consciousness”,
- Informatics Symposium at the 50<sup>th</sup> anniversary celebration weekend, University of Sussex (2011).
  - Department of Psychology, University of Granada, Spain (2010).
- “Granger causality analysis of steady-state EEG during propofol-induced anaesthesia”,  
Association for the Scientific Study of Consciousness, Kyoto, Japan (2011).
- “Integrated information, causal density and conscious level” (with Anil Seth), tutorial at  
Association for the Scientific Study of Consciousness, Kyoto, Japan (2011).
- “Shannon Information Capacity of Discrete Synapses”,
- Department of Informatics, University of Granada, Spain (2009).
  - Workshop on Multiple Timescales in the Dynamics of the Nervous System,  
International Centre for Theoretical Physics (ICTP), Trieste, Italy, (2008).
- “String Theory - A snapshot of the beauty and the beast of the Theory of Everything”,  
University of Edinburgh, (2007).

### **Public Outreach**

- “Why we need to figure out a theory of consciousness”. Article published in *The Conversation* (2018).
- “Measuring consciousness”. Talk to the society Liberate the Debate, University of Sussex (2018).
- “Post-growth complexity economics”. Talk to the society Pluralist Economics at Sussex (2018).
- “How capitalism without growth could build a more stable economy”. Article published in *The Conversation* (2018).
- “No-growth economy could mean fewer crashes and higher wages, study shows”. University of Sussex Broadcast co-authored article (2017). Picked up by *The Times*, *The Sun*, *Phys.org*, *Web India*, *MyScience*, *Yahoo News*.
- “Macroeconomics: there’s hope”. Article published on the blog “PRIME Economics” (2016). Interviewed for an article published in Youth United Press (2013).
- “The Neuroscience of Consciousness”, talk delivered to University of Kent Psychological Society (2012).
- Chaired programme of talks at “State of Mind – A Consciousness Expo” at the Brighton Corn Exchange (2012).
- “What is Consciousness?” poster at “State of Mind – A Consciousness Expo” at the Brighton Corn Exchange (2012).
- “Can Consciousness be Measured?” popular science talk at the Steelgrass Institute, Hawaii, USA (2010).

### **Student supervision**

- 2018: Masters student dissertation supervisor.
- 2013-16: Main supervisor for DPhil student Michael Schartner (submitted in 3 years; now postdoc in Pouget Lab, University of Geneva).
- 2012-14: On DPhil supervisory committee for Acer Chang.
- 2012-13: Co-supervisor for MRes student Alessandro Pappagallo.
- 2011-12: Co-supervisor for two Masters student dissertations.

### **Teaching positions held**

- 2018, 2017, 2016: Guest lecturer for “Data Science Research Methods” (MSc level), University of Sussex.
- 2015, 2013, 2012, 2011: Guest lecturer on the course “Neuroscience of Consciousness” (MSc level), University of Sussex.
- 2012: Guest lecturer for “Neuroscience and behavior” (2<sup>nd</sup> year undergraduate), Brighton and Sussex Medical School.
- 2012: Guest lecturer and tutor for “Seminars in Neuroscience” (2<sup>nd</sup> year undergraduate), University of Sussex.
- 2011: Course convenor, lecturer and tutor for “Mathematical and Computational Methods for Complex Systems” (MSc level – full 10 week course), University of Sussex.
- 2010: Tutor at the Barcelona Brain Cognition and Technology Summer School, Universitat Pompeu Fabra, Spain.
- 2009-2010: Mentor at the University of Sussex. I mentored three DPhil students via monthly meetings.
- 2004-2006: Tutor at the University of Oxford. Responsibilities: delivering workshops and revision classes, and marking assignments for undergraduate and postgraduate students.
- 2003-2004: Tutor at the University of Sussex. Responsibilities: delivering eight revision lectures for the physics module of the MCAT Medical Examination for entrance into US Graduate School; delivering undergraduate workshops; marking undergraduate coursework.
- 2003: Assistant tutor at the Postgraduate Summer School in Theoretical Physics, University of Utrecht, The Netherlands.

### **Other responsibilities**

- 2015-2018: Leader of the Theory and Modelling sub-group at the Sackler Centre for Consciousness Science.
- 2015, 2016: Panelist at workshop “Aiming for a fellowship”, University of Sussex
- 2015: Mentored a visiting junior research fellow at the University of Sussex.
- 2013: Co-organizer of two day Sackler Centre for Consciousness Science workshop “New Developments in Consciousness Science”, Wiston House, West Sussex, UK.
- 2011-2013: Co-organizer of the Neuroscience Seminar Series, University of Sussex.
- 2011-2013: Organizer of the Sackler Centre for Consciousness Science journal club, University of Sussex.

### **Recognition, Awards and Prizes**

- 2017: Selected for a Research Spotlight talk at the University of Sussex Impact Day, based on striking research achievement. Follow-up interview published as a “Research Spotlight” by Research and Knowledge Exchange group, University of Sussex.
- 2005: Jowett Exhibition, Balliol College, Oxford, awarded on academic merit.
- 2003: Horne Scholarship and College Prize, St John’s College, Cambridge, awarded for end of fourth year examination performance.
- 2002: Horne Scholarship and College Prize, St John’s College, Cambridge, awarded for end of third year examination performance.
- 2001: Horne Scholarship and College Prize, St John’s College, Cambridge, awarded for end of second year examination performance.
- 2000: Horne Scholarship and College Prize, St John’s College, Cambridge, awarded for end of first year examination performance.

### **Other Training**

- Jun 2007: Teaching Staffs’ Training Programme, University of Edinburgh.
- Jan-Feb 2004: Teaching Staffs’ Training Programme, University of Sussex.