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Qualifications

2015	Certificate of Completion of Training , general adult and liaison psychiatry	
2009	Membership of the Royal College of Psychiatrists	All parts at first attempt.
2007	Membership of the Royal Colleges of Physicians of the United Kingdom	All parts at first attempt.
2006	Doctor of Medicine , University of Cambridge	No corrections.
2001	Doctor of Philosophy , Experimental Psychology, University of Cambridge	No corrections.
2001	Bachelor of Medicine & Bachelor of Surgery (*), University of Cambridge	(*) Distinction
2000	Master of Arts , University of Cambridge	
1996	Bachelor of Arts (with Honours), University of Cambridge	
	Part IA: Anatomy, Biochemistry, Physiology, Sociology, Genetics	Class I
	Part IB: Anatomy, Neurobiology, Pathology, Pharmacology, Psychology, Reproductive Biology and Endocrinology	Class I
	Part II: Neuroscience	Class I [Ranked first]
1992	S-Level : Physics (1: distinction), Chemistry (1: distinction)	
1992	A-Level : Physics (A), Chemistry (A), Biology (A), Further Mathematics (A)	
1991	A-Level : Mathematics (A) (self-taught)	

Posts held

2011–present	Clinical Lecturer in Psychiatry , University of Cambridge.
2010–present	Honorary specialist registrar in general adult/liaison psychiatry , Cambridgeshire & Peterborough NHS Foundation Trust (CPFT). <ul style="list-style-type: none"> • 2015–present: community, Cambridge/Ely. • 2014–2015: ST6, acute inpatient and crisis resolution/home treatment, Fulbourn Hospital. • 2013–2014: ST5, liaison psychiatry, Addenbrooke's Hospital. • 2010–2013: ST4, liaison psychiatry, Addenbrooke's Hospital. • 2010–2010: ST4, rehabilitation and recovery team, Lucille van Geest Centre, Peterborough.
2010–2014	Wellcome Trust Fellow , Brain Mapping Unit, Department of Psychiatry, University of Cambridge. <ul style="list-style-type: none"> • 2012: Visiting fellow, Center for Computational Neuroscience & Neural Technology, Boston University. • 2010: Visiting fellow, Gatsby Computational Neuroscience Unit, University College London. • 2010–2011: Clinical research associate, University of Cambridge.
2007–2010	Academic clinical fellow in psychiatry , CPFT and University of Cambridge. <ul style="list-style-type: none"> • 2010–2010: ST3, general adult psychiatry, intake and treatment team, Peterborough. • 2009–2010: ST3, liaison psychiatry, Addenbrooke's Hospital. • 2009–2009: ST2, child and adolescent psychiatry, Darwin Centre for Young People, Cambridge. • 2008–2009: ST2, general adult psychiatry, Hinchingbrooke Hosp./Newtown Centre, Huntingdon. • 2008–2008: ST1, old age psychiatry, Addenbrooke's & Fulbourn Hospitals. • 2007–2008: Specialty registrar (ST1), general adult psychiatry, Fulbourn Hospital, Cambridge.
2005–2007	Senior house officer (SHO) in medicine . <ul style="list-style-type: none"> • 2007–2007: Cardiology and acute general internal medicine, Addenbrooke's. • 2006–2007: Respiratory medicine, Papworth Hospital, Cambridge (respiratory support and sleep centre; cystic fibrosis and lung defence service; pulmonary vascular diseases unit). • 2006–2006: Geriatrics and acute general internal medicine, Addenbrooke's. • 2005–2006: Hepatology and general internal medicine, Addenbrooke's.
2002–2005	Lecturer in Neuroscience , Behavioural and Clinical Neuroscience Centre (later Institute) and Department of Experimental Psychology, University of Cambridge.
2001–2002	House officer .

- 2002–2002 (surgery): trauma and orthopaedic surgery, general surgery, and colorectal surgery; Norfolk & Norwich University Hospital, Norwich.
 - 2001–2002 (medicine): general internal medicine, respiratory medicine, geriatrics, stroke medicine, and infectious diseases; Addenbrooke's Hospital, Cambridge.
- 1989–1996 **Systems support programmer** (1996), **programmer/systems manager** (1995), **computer assistant** (1994), **computer technician** (1992–1993), South Kent College, Folkestone; **clerk** (1992), Saga Services Ltd, Folkestone; freelance **systems consultant** (1994–1995) and **communications programmer** (1989–1990), including for Mencap, South East Kent Doctors On Call Ltd, H. V. Wooding Ltd, and Shepway Community Health Care Trust.

Prizes and distinctions

- 2014 **Higher Psychiatric Trainee of the Year**, Royal College of Psychiatrists
- 2007 **Sir Lionel Whitby Medal & Prize** (for MD of exceptional merit), University of Cambridge
- 2007 **Ralph Noble Prize** (for MD dissertation in psychiatry), University of Cambridge
- 2003 **Finalist, international Eppendorf & Science Prize for Neurobiology**
- 2002 **British Psychological Society Award for Outstanding Doctoral Research Contributions to Psychology**
- 2001 College Prize (for Medicine), St John's College, Cambridge
- 2001 Peter Brook Award for Psychiatric Research, University of Cambridge
- 1996 Northcott Prize (for Neuroscience) and Hughes Year Prize, St John's College
- 1996 Parke–Davis Prize for Neuroscience
- 1994 & 1995 Wright Prize (for Medical & Veterinary Sciences), St John's College

Publications

Books

- 2011 2. [Cardinal RN, Bullmore ET \(2011\). **The Diagnosis of Psychosis**. Cambridge University Press.](#)
- '*The Diagnosis of Psychosis* is an invaluable reference and clinical guidebook. It belongs on the bookshelf of every practicing physician. Professor Bullmore and Dr Cardinal have created something that has not been attempted for thirty years, since Lishman's landmark, *Organic Psychiatry*: an extensive, comprehensive and practical compendium of conditions that can manifest with psychosis and how to make an intelligent differential diagnosis. The book is highly readable and logically organized and is filled with academic and clinical pearls about both the exceptionally rare and the all too common clinical disorders in which psychosis is an important part of the clinical challenge.' – Daniel R. Weinberger (Director, Genes, Cognition and Psychosis Program), NIMH, NIH, USA.
- 2006 1. [Cardinal RN, Aitken MRF \(2006\). **ANOVA for the Behavioural Sciences Researcher**. Lawrence Erlbaum Associates, Mahwah, New Jersey.](#)

Primary data papers and review articles

† indicates ≥ 100 citations (ISI); ‡ indicates ≥ 300 citations; ◊ indicates $\geq 1,000$ citations.

- 2015 42. **Cardinal RN**, Savulich G, Mann LM, Fernández-Egea E. Association between antipsychotic/antidepressant drug treatments and hospital admissions in schizophrenia assessed using a mental health case register. *npj Schizophrenia* 1: 15035.
- 2015 41. Weed MR, Bookbinder M, Polino J, Keavy D, **Cardinal RN**, Simmermacher-Mayer J, Cometa FL, King D, Thangathirupathy S, Macor JE, Bristow LJ. Negative allosteric modulators selective for the NR2b subtype of the NMDA receptor impairs cognition in multiple domains. *Neuropsychopharmacology* 41: 568–577 (online 2015, print 2016).
- 2015 40. Brydges NM, Holmes MC, **Cardinal RN**, Harris AP, Hall J. Early life stress produces compulsive-like behavior in females. *Behavioral Neuroscience* 129: 300–308.
- 2015 39. Barker V, Romaniuk L, **Cardinal RN**, Pope M, Nicol K, Hall J. Impulsivity in borderline personality disorder. *Psychological Medicine* 45: 1955–1964.
- 2014 38. Rygula R, Clarke HF, **Cardinal RN**, Cockcroft GJ, Xia J, Roberts TW, Roberts AC. Role of central serotonin in anticipation of rewarding or punishing outcomes: effects of selective amygdala or orbitofrontal 5-HT depletion. *Cerebral Cortex* 25: 3064–3076 (online 2014, print 2015).
- 2014 37. Clarke HF (*), **Cardinal RN** (*), Rygula R, Hong YT, Fryer TD, Sawiak SJ, Ferrari V, Cockcroft G, Aigbirhio FI, Robbins TW, Roberts AC. Orbitofrontal dopamine depletion up-regulates caudate dopamine and produces behavioral changes akin to schizophrenia. *Journal of Neuroscience* 34: 7663–7676. (*) Joint first

authors.

- Demonstration that dopamine depletion of the orbitofrontal cortex causes striatal hyperdopaminergia and changes in reinforcement learning relevant to schizophrenia, assessed using Bayesian hierarchical modelling.
- 2014 36. Gillan CM, Morein-Zamir S, Kasar M, Fineberg NA, Sule A, Sahakian BJ, **Cardinal RN**, Robbins TW. Counterfactual processing of economic action–outcome alternatives in obsessive–compulsive disorder: Further evidence of impaired goal-directed behavior. *Biological Psychiatry* 75: 639–646 (online 2013, print 2014).
- 2010 35. **Cardinal RN**, Aitken MRF. Whisker: a client–server high-performance multimedia research control system. *Behavior Research Methods* 42: 1059–1071.
- To 2011, used in >180 primary data papers and by 27 academic institutions across Europe and North America, 6 government agencies (in China, Israel, Singapore, UK, and the USA), and >16 commercial entities including 6 of the largest 12 pharmaceutical companies worldwide.
- 2010 34. **Cardinal RN**, Everitt BJ. Neural systems of motivation. In Koob GF, Thompson RF, Le Moal M (eds), *Encyclopedia of Behavioral Neuroscience*, volume 2, pp. 376–386. Elsevier/Academic Press, Oxford.
- 2010 33. **Cardinal RN**. Analysis of variance. In Weiner IB, Craighead WE (eds), *Corsini Encyclopedia of Psychology* (fourth edition), pp. 92–98. John Wiley & Sons, Hoboken, New Jersey.
- 2009 32. **Cardinal RN**, Shah DN, Edwards CJ, Hughes GRV, Fernández-Egea E. Psychosis and catatonia as a first presentation of antiphospholipid syndrome. *British Journal of Psychiatry* 195: 272.
- 2009 31. **Cardinal RN**, Gregory CA. Osteomalacia and vitamin D deficiency in a psychiatric rehabilitation unit: case report and survey. *BMC Research Notes* 2: 82.
- BMC Research Notes ‘highly accessed’ article.
- 2007 30. Zernig G, Ahmed SH, **Cardinal RN**, Morgan D, Acquas E, Foltin RW, Vezina P, Negus SS, Crespo JA, Stöckl P, Grubinger P, Madlung E, Haring C, Kurz M, Saria A. Explaining the escalation of drug use in substance dependence: Models and appropriate animal laboratory tests. *Pharmacology* 80: 65–119.
- 2007 29. Chamberlain SR, Müller U, Deakin JB, Corlett PR, Dowson J, **Cardinal RN**, Aitken MRF, Robbins TW, Sahakian BJ. Lack of deleterious effects of buspirone on cognition in healthy male volunteers. *Journal of Psychopharmacology* 21: 210–215 (online 2006, print 2007).
- 2006 † 28. **Cardinal RN**. Neural systems implicated in delayed and probabilistic reinforcement. *Neural Networks* 19: 1277–1301.
- Neural Networks *Most Cited Article 2006–2010* award, Elsevier.
- 2006 27. Robbins TW, **Cardinal RN**, Di Ciano P, Halligan PWG, Hellems KGC, Lee JCL, Everitt BJ. Neuroscience of drugs and addiction. UK Office of Science and Technology *Foresight: Brain Science, Addiction and Drugs* project, 13 July 2005. Chapter 3 of Nutt D, Robbins TW, Stimson GV, Ince M, Jackson A (eds), *Drugs and the Future: Brain Science, Addiction and Society*, pp. 11–88. Academic Press, London, 2006.
- ‘This comprehensive and scholarly review of the tremendous wealth of data concerning links between psychoactive substances with abuse liability, brain function and behaviour provides one of the best treatments of this topic ever written.’ – Anthony Phillips, Professor and Director of the UBC Institute of Mental Health, University of British Columbia, Vancouver, Canada.
- ‘[A]n excellent job of reviewing the state of current knowledge.’ – Elliot Stein, Professor of Neuroscience, Medical College of Wisconsin, USA.
- 2006 26. Winstanley CA, Theobald DEH, Dalley JW, **Cardinal RN**, Robbins TW. Double dissociation between serotonergic and dopaminergic modulation of medial prefrontal and orbitofrontal cortex during a test of impulsive choice. *Cerebral Cortex* 16: 106–114 (online 2005, print 2006).
- 2005 25. **Cardinal RN**, Howes NJ. Effects of lesions of the nucleus accumbens core on choice between small certain rewards and large uncertain rewards in rats. *BMC Neuroscience* 6: 37.
- BMC Neuroscience ‘highly accessed’ article.
- 2005 24. Cheung THC, **Cardinal RN**. Hippocampal lesions facilitate instrumental learning with delayed reinforcement but induce impulsive choice in rats. *BMC Neuroscience* 6: 36.
- BMC Neuroscience ‘highly accessed’ article.
- 2005 23. **Cardinal RN**, Cheung THC. Nucleus accumbens core lesions retard instrumental learning and performance with delayed reinforcement in the rat. *BMC Neuroscience* 6: 9.
- BMC Neuroscience ‘highly accessed’ article.
- 2004 22. Dalley JW, Theobald DE, Bouger P, Chudasama Y, **Cardinal RN**, Robbins TW. Cortical cholinergic function and deficits in visual attentional performance in rats following 192 IgG-saporin-induced lesions of the medial prefrontal cortex. *Cerebral Cortex* 14: 922–932.
- 2004 † 21. Winstanley CA, Theobald DEH, **Cardinal RN**, Robbins TW. Contrasting roles of basolateral amygdala and orbitofrontal cortex in impulsive choice. *Journal of Neuroscience* 24: 4718–4722.
- 2004 20. **Cardinal RN**. Waiting for better things. *The Psychologist* 17: 684–687.
- 2004 ‡ 19. Dalley JW, **Cardinal RN**, Robbins TW. Prefrontal executive and cognitive functions in rodents: neural and neurochemical substrates. *Neuroscience and Biobehavioral Reviews* 28: 771–784.

ISI citation classic.

- 2004 † 18. **Cardinal RN**, Everitt BJ. Neural and psychological mechanisms underlying appetitive learning: links to drug addiction. *Current Opinion in Neurobiology* 14(2): 156–162.
- 2004 † 17. **Cardinal RN**, Winstanley CA, Robbins TW, Everitt BJ. Limbic corticostriatal systems and delayed reinforcement. *Annals of the New York Academy of Sciences* 1021: 33–50.
- 2003 16. **Cardinal RN**. Succumbing to instant gratification without the nucleus accumbens. Finalist review essay for Eppendorf & Science Prize for Neurobiology, 2003. *Science Online*, cited in *Science* 302: 801, via <http://www.sciencemag.org/site/feature/data/prizes/eppendorf/2003/2003winners.xhtml>.
- 2003 15. **Cardinal RN**, Parkinson JA, Hall J, Everitt BJ. The contribution of the amygdala, ventral striatum, and prefrontal cortex to emotion and motivated behaviour. *International Congress Series* 1250: 347–370. In Ono T, Matsumoto G, Llinás RR, Berthoz A, Norgren R, Nishijo H, Tamura R (eds), *Cognition and Emotion in the Brain*. Elsevier, Amsterdam.
- 2003 14. **Cardinal RN**, Parkinson JA, Djafari Marbini H, Toner AJ, Bussey TJ, Robbins TW, Everitt BJ. Role of the anterior cingulate cortex in the control over behavior by Pavlovian conditioned stimuli in rats. *Behavioral Neuroscience* 117: 566–587.
Investigation of the contribution of the anterior cingulate cortex to Pavlovian conditioning, demonstrating its role in selecting amongst similar stimuli differentially associated with reward.
- 2003 † 13. Everitt BJ, **Cardinal RN**, Parkinson JA, Robbins TW. Appetitive behavior: the impact of amygdala-dependent mechanisms of emotional learning. *Annals of the New York Academy of Sciences* 985: 233–250.
- 2003 12. **Cardinal RN**, Robbins TW, Everitt BJ. Choosing delayed rewards: perspectives from learning theory, neurochemistry, and neuroanatomy. Chapter 6 of Vuchinich RE, Heather N (eds), *Choice, Behavioural Economics and Addiction*, pp. 183–213 and 217–218. Elsevier, Amsterdam.
- 2002 † 11. Parkinson JA, Dalley JW, **Cardinal RN**, Bamford A, Fenhert B, Lachenal G, Rudarakanchana N, Halkerston KM, Robbins TW, Everitt BJ. Nucleus accumbens dopamine depletion impairs both acquisition and performance of appetitive Pavlovian approach behaviour: implications for mesoaccumbens dopamine function. *Behavioural Brain Research* 137: 149–163.
- 2002 10. **Cardinal RN**, Daw N, Robbins TW, Everitt BJ. Local analysis of behaviour in the adjusting-delay task for assessing choice of delayed reinforcement. *Neural Networks* 15: 617–634.
- 2002 ◇ 9. **Cardinal RN**, Parkinson JA, Hall J, Everitt BJ. Emotion and motivation: the role of the amygdala, ventral striatum, and prefrontal cortex. *Neuroscience and Biobehavioral Reviews* 26: 321–352.
ISI citation classic. Comment in *Curr. Op. Neurobiol.* 14:148, 14:178.
- 2002 † 8. **Cardinal RN**, Parkinson JA, Lachenal G, Halkerston KM, Rudarakanchana N, Hall J, Morrison CH, Howes SR, Robbins TW, Everitt BJ. Effects of selective excitotoxic lesions of the nucleus accumbens core, anterior cingulate cortex, and central nucleus of the amygdala on autoshaping performance in rats. *Behavioral Neuroscience* 116: 553–567.
Investigation of the neural basis of performance of an autoshaped response. With previous results, this study demonstrates structures playing specific roles in the learning (yet not the performance) of behaviour based on stimulus–reward associations.
- 2001 † 7. Di Ciano P, **Cardinal RN**, Cowell RA, Little SJ, Everitt BJ. Differential involvement of NMDA, AMPA/kainate, and dopamine receptors in the nucleus accumbens core in the acquisition and performance of Pavlovian approach behavior. *Journal of Neuroscience* 21: 9471–9477.
- 2001 † 6. Dalley JW, McGaughy J, O’Connell MT, **Cardinal RN**, Levita L, Robbins TW. Distinct changes in cortical acetylcholine and noradrenaline efflux during contingent and non-contingent performance of a visual attentional task. *Journal of Neuroscience* 21: 4908–4914.
- 2001 ‡ 5. **Cardinal RN**, Pennicott DR, Sugathapala CL, Robbins TW, Everitt BJ. Impulsive choice induced in rats by lesions of the nucleus accumbens core. *Science* 292: 2499–2501.
ISI citation classic. Fast-track publication. Coverage included (* = live interview, † = recorded interview): **Radio and television:** The *Today* programme (the UK’s flagship news broadcast) on BBC Radio 4 (*); BBC Television News (BBC 1, BBC News 24), BBC Radio News, BBC Radio 1 *Newsbeat* (†), BBC Radio 5 Live (*), BBC Radio Cambridgeshire (*), BBC Radio Scotland (†), BBC London Live (*), British Forces Broadcasting (*), BBC Radio 4 *The World Tonight*, BBC Radio Shropshire (*), and several overseas radio stations. **Wire services, newspapers, magazines:** Featured by Reuters, the Press Association, the *Daily Telegraph*, the *Daily Express*, the *Sun*, the *Financial Times*, Brazil’s largest daily the *Folha de S. Paulo*, the *Cambridge Evening News*, *Crime Times* 7(3):4–5, *Sciences et Avenir* 653 July 2001. **Journals:** *Nature Reviews Neuroscience* 2: 457, *Lancet* 348: 949–950.
- 2001 † 4. Rahman S, Sahakian BJ, **Cardinal RN**, Rogers RD, Robbins TW. Decision-making and neuropsychiatry. *Trends in Cognitive Sciences* 5: 271–277.
- 2000 † 3. **Cardinal RN**, Robbins TW, Everitt BJ. The effects of *d*-amphetamine, chlordiazepoxide, alpha-flupenthixol and behavioural manipulations on choice of signalled and unsignalled delayed reinforcement in rats. *Psychopharmacology* 152: 362–375.
- 2000 2. Parkinson JA, **Cardinal RN**, Everitt BJ. Limbic cortical-ventral striatal systems underlying appetitive conditioning. *Progress in Brain Research* 126: 263–285.
- 2000 1. Everitt BJ, **Cardinal RN**, Hall J, Parkinson JA, Robbins TW. Differential involvement of amygdala

subsystems in appetitive conditioning and drug addiction. Chapter 10 of Aggleton JP (ed.), *The amygdala: a functional analysis* (second edition), pp. 353–390. Oxford University Press, New York.

Abstracts and conference proceedings

- 2014 xxi. Giuliano C, Oliver-Pena Y, Cardinal RN, Bullmore ET, Goodlett CR, Belin D, Everitt BJ. Compulsive alcohol-seeking behaviour is attenuated by inhibiting μ -opioid receptors. Program No. 429.10. **Society for Neuroscience**, 15–19 November 2014, Washington, DC, USA.
- 2014 xx. **Cardinal RN**. Computational models of thalamocortical unsupervised attentional selection and competitive learning. Program No. 835.08. **Society for Neuroscience**, Washington, DC.
- 2014 xix. Weed MR, Bookbinder M, Polino J, Keavy D, **Cardinal RN**, Simmermacher-Mayer J, Cometa FL, Bristow LJ. A negative allosteric modulator selective for the NR2b subtype of NMDA receptors impairs cognition in cynomolgus monkeys. Program No. 265.23. **Society for Neuroscience**, Washington, DC.
- 2013 xviii. Barker V, Pope M, Romaniuk L, **Cardinal RN**. Impulsivity in borderline personality disorder. **Royal College of Psychiatrists International Congress**, 5 July 2013, Edinburgh, UK.
- 2011 xvii. **Cardinal RN**, Bullmore ET. The diagnosis of psychosis: a review and clinical guide to the diagnosis of conditions causing psychotic symptoms. **Royal College of Psychiatrists Section of Neuropsychiatry** conference, 8–9 September 2011, Cambridge, UK.
- 2004 xvi. **Cardinal RN**. Is it worth the wait? Neurobiology of delayed reinforcement. **Autumn School in Cognitive Neuroscience, University of Oxford**, 27–30 September 2004, Oxford, UK.
- 2004 xv. Murphy ER, Dalley JW, Laane KF, **Cardinal RN**, Hellems KGC, Robbins TW. Local glutamate receptor antagonism in the rat prefrontal cortex disrupts response inhibition in a spatial attentional task. **Society for Neuroscience 34th Annual Meeting**, 23–27 October 2004, San Diego, California, USA.
- 2004 xiv. Lehmann O, Eagle DM, Ito R, **Cardinal RN**, Robbins TW. Involvement of prelimbic cortex and hippocampus in visuospatial attention and working memory in rats: a comparison of delayed matching and nonmatching to sample performance. **Society for Neuroscience**, San Diego.
- 2004 xiii. **Cardinal RN**. Neurobiology of delayed reinforcement. **British Psychological Society Annual Conference**, 15–17 April 2004, London, UK.
- 2003 xii. Dalley JW, Theobald DEH, **Cardinal RN**, Robbins TW. Monoamines, acetylcholine and contingency of reward delivery in instrumental behaviour. **Monitoring Molecules in Neuroscience: 10th International Conference on In Vivo Methods**, 24–27 June 2003, Stockholm, Sweden.
- 2003 xi. **Cardinal RN**. The anatomical basis of desire and addiction. **Journal of Neurology, Neurosurgery and Psychiatry** 74: 835. British Neuropsychiatry Association Annual Meeting, 14 February 2003, London.
- 2003 x. **Cardinal RN**, Dalley JW, Passetti F, Theobald DE, Winstanley CA, Robbins TW. Fronto-executive functions in rodents: neural and neurochemical substrates. **International Behavioral Neuroscience Society 12th Annual Meeting**, 23–27 April 2003, San Juan, Puerto Rico.
- 2001 ix. Di Ciano P, **Cardinal RN**, Cowell R, Little SJ, Everitt BJ. Triple dissociation in the effects of glutamatergic and dopaminergic antagonists in the nucleus accumbens core on the acquisition and performance of appetitive approach to a Pavlovian conditioned stimulus. **Society for Neuroscience Abstracts** 27. Society for Neuroscience 31st Annual Meeting, 10–15 November 2001, San Diego, CA, USA.
- 2001 viii. **Cardinal RN**, Pennicott DR, Sugathapala CL, Robbins TW, Everitt BJ. Impulsive choice induced in rats by lesions of the nucleus accumbens core, but not of anterior cingulate or medial prefrontal cortex. **Society for Neuroscience Abstracts** 27. SFN, San Diego.
- 2001 vii. Di Ciano P, **Cardinal RN**, Cowell R, Little SJ, Everitt BJ. Triple dissociation in the effects of NMDA, AMPA/KA and DA antagonists on the acquisition and performance of discriminated Pavlovian approach to a conditioned stimulus. First joint meeting, **European Brain and Behaviour Society and European Behavioural Pharmacology Society**, 8–12 September 2001, Marseille, France.
- 2000 vi. Dalley JW, McGaughy J, **Cardinal RN**, Levita L, Everitt BJ, Robbins TW. Increased release of acetylcholine and noradrenaline in rat medial prefrontal cortex during contingent and non-contingent performance of a visual attentional task. **Society for Neuroscience Abstracts** 26: 2225. Society for Neuroscience 30th Annual Meeting, 4–9 November 2000, New Orleans, Louisiana, USA.
- 2000 v. Everitt BJ, Parkinson JA, Lachenal G, Halkerston KM, Rudarakanchana N, **Cardinal RN**, Hall J, Morrison CH, Dalley JW, Howes SR, Robbins TW. Effects of limbic corticostriatal lesions on autoshaping performance in rats. **Society for Neuroscience Abstracts** 26: 979. SFN, New Orleans.
- 2000 iv. **Cardinal RN**, Parkinson JA, Djafari Marbini H, Toner AJ, Robbins TW, Everitt BJ. Role of the anterior cingulate cortex in the control over behaviour by Pavlovian conditioned stimuli in rats. **Society for Neuroscience Abstracts** 26: 980. SFN, New Orleans.
- 2000 iii. **Cardinal RN**, Parkinson JA, Robbins TW, Dickinson A, Everitt BJ. Effects of lesions of the nucleus accumbens core and shell on response-specific Pavlovian-instrumental transfer. **Journal of Psychopharmacology** 14(3) (supplement): A68. British Association for Psychopharmacology Summer Meeting, 16–19 July 2000, Cambridge, UK.
- 2000 ii. **Cardinal RN**, Lachenal G, Parkinson JA, Robbins TW, Everitt BJ. Effects of anterior cingulate cortex lesions on responding for conditioned reinforcement, discrete fear conditioning, autoshaping performance and Pavlovian-instrumental transfer. **European Journal of Neuroscience** 12 (supplement 11): 88. Federation of European Neuroscience Societies Second Forum Meeting, 24–28 June 2000, Brighton, UK.
- 1999 i. **Cardinal RN**, Everitt BJ, Robbins TW. Amphetamine interacts with cue stimuli to affect preference for delayed reinforcement. **Behavioural Pharmacology** 10 (supplement 1): S15–S16. First Congress of the Behavioral Pharmacology Society and European Behavioural Pharmacology Society, 1–4 September 1999, Boston, MA, USA.

Software for research and clinical practice

- 2015– **Cardinal RN. CRATE: clinical records anonymisation and text extraction**. Open-source pipeline including anonymisation, framework for external natural language processing tools, auditing, and web-based query and consent-to-contact management. See <https://github.com/RudolfCardinal>.
- 2013– **Cardinal RN. Cambridge Cognitive and Psychiatric Assessment Kit (CamCOPS)**. Open-source secure multi-platform tablet software for bedside cognitive and psychiatric assessment. See

- <http://www.camcops.org>.
- 2005 **Cardinal RN. Liver disease prognosis.** Calculates MELD, GAHS, Childs–Pugh, modified discriminant function, UKELD, and related scores, with survival predictors.
- 2001– **Cardinal RN, Aitken MRF. Whisker,** versions 2–4. Adds graphical output on multiple displays, video playback, multi-channel audio output, mouse/keyboard/touchscreen support, and development kits for several languages. See <http://www.whiskercontrol.com>.
- 2000– **Cardinal RN. Behavioural clients for Whisker,** including the MonkeyCantab suite.
- 2000 **Cardinal RN. Whisker,** version 1. Behavioural research control software; controls digital input/output devices using a TCP-based client–server system.
- 1997– **Cardinal RN. Additional open-source code** at <http://pobox.com/~rudolf>; <https://github.com/RudolfCardinal>.

Other publications

- 2013 **Cardinal RN.** Steroid-induced psychosis. *Crohn's and Colitis UK* newsletter, summer: 7.
- 2012 **Cardinal RN.** Book review. “Case Studies: Stahl’s Essential Psychopharmacology” by Stephen M. Stahl. *Acta Psychiatrica Scandinavica* 125: 504.
- 2008 **Cardinal RN.** Calculation of cost-effectiveness of resident medical cover for psychiatric hospitals. *BMJ*, 24 August 2008; http://www.bmj.com/cgi/eletters/337/jul31_3/a942#201026.
- 2005 **Cardinal RN.** Power to detect reduction in mortality. *BMJ*, 4 September 2005; <http://www.bmj.com/cgi/eletters/331/7515/468#115688>.
- 2005 **Cardinal RN.** Animal testing. *The Times*, 1 September 2005, p. 18.
- 1998 **Cardinal RN.** Hooked on hash? *Cambridge Medicine*.

Bibliometrics

Source and date	ISI Web of Science, Feb 2016
Indexed publications	36
Citations	4,780
ISI citation classics (number of papers with ≥ 300 citations each)	4
h index (maximum h such that h papers have $\geq h$ citations each)	24
g index (maximum g such that g papers have $\geq g^2$ citations together)	36
Citations per paper	133

Funding

- 2016–2021 Collaborator: Wellcome Trust Investigator Award in Biomedical Science (Angela C. Roberts). *Fractionating the functions of primate ventromedial prefrontal cortex of relevance to depression*. £1.9M.
- 2014–2021 Collaborator: Wellcome Trust Senior Investigator Award in Biomedical Science (Trevor W. Robbins). *Fronto-striatal systems in impulsive–compulsive disorders*. £2.9M.
- 2011–2014 Collaborator: Wellcome Trust Intermediate Clinical Fellowship (Jeremy Hall). *A biological study of borderline personality disorder*. £824k.
- 2010–2014 Principal investigator: Wellcome Trust Postdoctoral Fellowship for MB/PhD Graduates. *Developing models of thalamocortical unsupervised attentional selection and competitive learning*. £194k.
- 2007–2010 UK NHS National Institute for Health Research (NIHR) Academic Clinical Fellowship in Psychiatry.
- 2002–2007 UK Medical Research Council (MRC) Lectureship in Neuroscience (taken until 2005).
- 1997–2000 UK MRC research studentship.
- 1997–2000 James Baird award, University of Cambridge School of Clinical Medicine.

Research supervision

- 2003–2006 PhD (as advisor): Sanne de Wit (University of Cambridge). *Resolution of conflict between goal-directed actions*. Supervisor: Anthony Dickinson.
- 2003–2004 MPhil: Timothy H.C. Cheung (University of Cambridge). *Contributions of the ventral striatum and the hippocampus to the processing of delayed reinforcement in the rat*.
- 2004–2005 Undergraduate: Christopher Burnie, Louis G.S. Verdi, Steven T. Romans (Part II Psychology, University of

	Cambridge). <i>Developing an audiovisual intradimensional/extradimensional set-shifting task for the rat.</i>
2003–2004	Undergraduate: Nathan J. Howes (Part II Psychology, University of Cambridge). <i>Effects of nucleus accumbens core lesions on choice involving uncertain reward.</i>
2003–2004	Undergraduate: Minh L. Lam, Ranbir S. Sandhu (Part II Psychology, University of Cambridge). <i>Effects of guanfacine on human cognition.</i>
2002–2003	Undergraduate: Timothy H.C. Cheung (Part II Psychology, University of Cambridge). <i>Effect of nucleus accumbens core lesions on free-operant learning with delayed reinforcement.</i>
2002–2003	Undergraduate: Laura C.E. Sorensen, Aidyn Kussainov, Shahzad M. Alikhan, Rosemary A.B. Marsh (Part II Psychology, University of Cambridge). <i>Effects of buspirone on human cognition.</i>
1999–2000	Undergraduate: Andrew J. Toner, Hosnieh Djafari-Marbini (Part II Psychology, University of Cambridge). <i>Role of anterior cingulate cortex in Pavlovian conditioning.</i>
1999–2000	Undergraduate: David R. Pennicott, C. Lakmali Sugathapala (Part II Psychology, University of Cambridge). <i>Role of anterior cingulate cortex in choice involving delayed reinforcement.</i>
1999	Maîtrise: Guillaume Lachenal (École Normale Supérieure, Paris). <i>Effect of limbic lesions on autoshaping performance.</i>

External invited lectures and talks (accepted); public engagement

2015	<i>Psychiatry.</i> Sixth form careers talks, Addenbrooke's Hospital.
2013	<i>Ghosts in the mind: the nature and causes of psychosis.</i> Bedford School Medical Association.
2010	<i>Delayed reinforcement: an update on animal studies.</i> Gatsby Computational Neuroscience Unit, UCL, Queen Square, London, 26 May 2010.
2008	<i>Managing behavioural problems in dementia.</i> British Geriatric Society, Cambridge, 1 April 2008.
2004	<i>Neural Mechanisms of Decision Making.</i> Symposium within the Autumn School in Cognitive Neuroscience, University of Oxford, 27–30 September 2004.
2004	<i>Neuropsychology of Reinforcement Processes in the Rat.</i> Award lecture for the British Psychological Society Annual Conference, London, 15–17 April 2004.
2003	<i>Delayed reinforcement: neurochemistry and neuroanatomy.</i> Gatsby Computational Neuroscience Unit, UCL, Queen Square, London, 21 October 2003.
2003	<i>Adolescent Brain Development: Vulnerabilities and Opportunities.</i> New York Academy of Sciences; New York City, New York, USA, 18–20 September 2003.
2003	<i>Neurobiology of Cognition in Laboratory Animals.</i> Symposium within the International Behavioral Neuroscience Society Annual Meeting; San Juan, Puerto Rico, 23–27 April 2003.
2003	<i>The Neural Basis of Desire and Addiction.</i> British Neuropsychiatry Association Annual Meeting; London, UK, 14 February 2003.
2002	<i>Choice, Behavioral Economics and Addiction.</i> Birmingham, Alabama, USA, 15–17 March 2002.

Teaching and teaching awards

2016	<i>Depression.</i> School of Clinical Medicine, University of Cambridge.
2015	“Excellent Teaching Award”, Cambridge Clinical Students Society.
2015	<i>Psychiatric presentations of organic disease.</i> MRCPsych course, Fulbourn Hospital.
2015	<i>Psychosis: mechanisms, investigations, rating scales, outcome measures.</i> MRCPsych course, Fulbourn Hospital.
2013	<i>Post-traumatic stress disorder.</i> MRCPsych course, Fulbourn Hospital.
2013	<i>Computational modelling and its relevance to psychiatry.</i> Cambridge Neuropsychiatry Day, University of Cambridge and CPFT.
2013–2014	<i>Masterclass: latest advances in psychopharmacology / Case discussion.</i> Cambridge Psychopharmacology Programme, Cambridge University Press/Neuroscience Education Institute, Cambridge.
2012	<i>Schizophrenia: early intervention and assessment.</i> MRCPsych course, Fulbourn Hospital.
2010	<i>Physical examination in psychiatry.</i> MRCPsych course, Fulbourn Hospital.
2010	<i>Unipolar depression.</i> Undergraduate psychiatry course, Peterborough.
2005–present	Clinical supervision of junior doctors; ad hoc teaching (medical students, junior doctors, other clinicians).
2005–2006	<i>Reasoning about uncertainty and learning strategies in medicine.</i> Psychology self-directed exercise, University of Cambridge.
2003–2005	<i>Statistics.</i> Second-year psychology practical series, University of Cambridge.

2002–2005	<i>Introduction to Neurobiology</i> . Second-year psychology practical, University of Cambridge.
2002–2005	<i>Brain Mechanisms of Memory and Cognition</i> . Third-year psychology and neuroscience lecture course, University of Cambridge.
2002–2005	Large-group (30–200) and small-group (1–6) teaching in neuroscience and psychology at second- and third-year undergraduate level, University of Cambridge. Coordinating supervisor for some colleges. Teaching related to own courses, plus <i>Brain Mechanisms of Motivation</i> (third-year psychology), <i>Neurobiology and Human/Animal Behaviour</i> (second-year medicine and veterinary medicine).
2004, '14–15	<i>Memory</i> . MRCPsych course, Fulbourn Hospital.
2003–2004	<i>Guide to ANOVA</i> . Dept of Experimental Psychology, University of Cambridge.
2003–2004	Graduate programming classes, Dept of Experimental Psychology, University of Cambridge.
2003–2004, 2014–15	<i>Emotion and Motivation</i> . MRCPsych course, Fulbourn Hospital, Cambridge.
2002–2004	<i>Emotion and Motivation</i> . Second-year psychology lecture course, University of Cambridge.
1996–2001	Supervisor in endocrinology, reproductive biology, neurophysiology/neurobiology/neuroscience, and psychology. St John's College, Downing College, New Hall, and Clare College, University of Cambridge.

Examining

2015	PhD internal examiner, University of Cambridge. Michael Gottschalk: <i>Pathological and predictive molecular biomarkers in affective and anxiety disorders</i> .
2013	PhD internal examiner, University of Cambridge. Josh Keeler: <i>Instrumental response sequencing: dopaminergic modulation and behavioural control</i> .
2011	PhD external examiner, University of Nottingham. Lourdes Valencia Torres: <i>An investigation of the neural mechanisms of interval timing behaviour</i> .
2009	PhD internal examiner, University of Cambridge. Sietse Jonkman: <i>Neural mechanisms underlying the acquisition of instrumental behaviour in rats</i> .
2007	DPhil external examiner, University of Oxford. Peter Rudebeck: <i>Emotion, social behaviour and decision-making in the medial and orbital frontal cortices</i> .
2004–2005	Senior Assessor (examiner) for the Medical & Veterinary Sciences Tripos (MVST) Experimental Psychology I _B Option, University of Cambridge.
2003–2005	Assessor (examiner) for the Natural Sciences Tripos (NST) Part II Neuroscience, University of Cambridge.
2003	Assessor (examiner) for the MVST Experimental Psychology I _B Option, University of Cambridge.

Leadership and administration

2015–	CPFT Research & Development leadership team.
2013–2014	Leadership training course, NHS East of England Multiprofessional Deanery.
2012–	Academic lead clinician, CPFT Research Database , including appointment interviewing.
2012–	Athena SWAN Steering/Governance Group , School of Clinical Medicine.
2012–2013	Review Panel on General Practice Academic Clinical Fellowships , University of Cambridge.
2010–2014	Protocol Review Panel , Behavioural & Clinical Neuroscience Institute, University of Cambridge.
2010–2014	Day Coordinator, Liaison Psychiatry Service, CPFT.
2008–2009	Medical Education Committee & Rota Group, CPFT. Junior doctor representative; redesigned rota.
2006	Redesigned the junior medical rota for Addenbrooke's Hospital, achieving more doctors, hours reduction, better team continuity, and more balanced out-of-hours ward cover.
2004–2005	MVST Neurobiology and Human Behaviour Committee , University of Cambridge.
2004–2005	Second MB (Bachelor of Medicine) Exemptions Committee , University of Cambridge.
2004–2005	MVST Part I (preclinical medical/veterinary education) Committee , University of Cambridge.
2004–2005	Course organizer , MVST I _B Experimental Psychology Special Option course, University of Cambridge.
2004–2005	Course organizer , Experimental Psychology component of the MVST I _B Neurobiology & Human Behaviour course, University of Cambridge.
2004	Undergraduate admissions interviewer, Selwyn College, Cambridge.
2003	Director of Undergraduate Teaching , Dept of Experimental Psychology, University of Cambridge.
2003–2005	Chair, Computer Management Group , Dept of Experimental Psychology, University of Cambridge.
2002	Appointment interviewer, Department of Experimental Psychology, University of Cambridge.

Refereeing

Papers	<p><i>Addiction</i> <i>Behavioral Neuroscience</i> <i>Behavioural Brain Research</i> <i>Behavioural Pharmacology</i> <i>Behavioural Processes</i> Biological Psychiatry <i>BMC Neuroscience</i> Brain <i>Drug and Alcohol Dependence</i> <i>European Journal of Neuroscience</i> <i>International Journal of Neural Systems</i> <i>Journal of Comparative Psychology</i> <i>Journal of Experimental Psychology: Animal Behavior Processes</i> Journal of Neuroscience</p>	<p><i>Journal of Pediatric Endocrinology and Metabolism</i> <i>Journal of Psychiatric Research</i> <i>Neural Networks</i> Neuropsychopharmacology Neuroscience & Biobehavioral Reviews <i>PLoS Computational Biology</i> <i>Progress in Neuro-Psychopharmacology and Biological Psychiatry</i> Psychological Medicine <i>Psychology & Neuroscience</i> <i>Psychopharmacology</i> <i>Quarterly Journal of Experimental Psychology</i> Science</p>
Books	Cambridge University Press	
Grants	<p>Wellcome Trust UK Medical Research Council UK Biotechnology and Biological Sciences Research Council Nederlandse Organisatie voor Wetenschappelijk Onderzoek</p>	
Fellowships	<p>Wellcome Trust Christ's College, Cambridge Downing College, Cambridge</p>	

Other skills

Clinical procedures. *Experienced in:* peripheral venous cannulation, venepuncture, arterial blood sampling, suturing and wound closure, electrocardiography, spirometry, urinary catheterization, pleural fluid aspiration, thoracocentesis, ascitic fluid aspiration, paracentesis, central venous cannulation (internal jugular and femoral approaches), DC cardioversion, external cardiac pacing, exercise tolerance test supervision, care and removal of pericardial drains, lumbar puncture, intercostal drain insertion (Argyle and Seldinger techniques) and removal, and electroconvulsive therapy (ECT). *Performed:* endotracheal intubation, echocardiography, oesophagogastroduodenoscopy with biopsy, nasogastric tube insertion, rigid sigmoidoscopy, and rectal biopsy, temporary pacing wire insertion, dynamic hip screw insertion, and minor surgical procedures. *Advanced Life Support (ALS) provider certification*, 2007 (selected for ALS Instructor training).

Computing. I have been using computers since 1983 and programming since 1985. I am fluent in the computer languages C, C++ (with Boost, DirectX, MFC, MPI, ODBC, STL, and multithreading environments), 6502 assembler, ARM assembler, BASIC, Javascript, Perl, Python, R, and SQL in various flavours. I am familiar with bash, HTML, and Java, and have also used x86 assembler, Awk, CMake, Lisp, Lua, Matlab, Pascal, Octave, and Sage. I have experience of using, programming for and administering Android, iOS, Linux and UNIX, MS-DOS, OS/2, Novell Netware (3, 4), RISC OS, Windows (2, 3, NT, 95, 98, 2000, XP, Vista, 7, 8, 10), database engines (DBase, Dataflex, MySQL, Oracle, SQLite, SQL Server), IP and IPX networks, and hundreds of application programs, along with associated hardware.

Behavioural neuroscience. Stereotaxic neurosurgery in rodents, including intracranial cannulation and excitotoxic lesion techniques. Tissue perfusion; histological staining and assessment. Behavioural task design and real-time control programming. Intracerebral infusion in freely-moving animals. Systemic psychopharmacology. Computer simulation. Statistical analysis. Manuscript preparation and editing, public speaking, and refereeing.

Animals (Scientific Procedures) Act. UK Home Office Personal Licence holder (1997–2007; modules 1–4, 1997; module 5, 2003) and Deputy Project Licence holder (2004–2005).

Mental Health Act. Approved under section 12(2) of the Mental Health Act as having special experience in the diagnosis or treatment of mental disorder (2010–). Approved as an Approved Clinician (2015–).

Financial declarations other than income from primary/honorary employers

2014	Lecture fee from the Neuroscience Education Institute.
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- 2011– Book royalty income from Cambridge University Press.
- 2010– Occasional fees from UK government agencies for Mental Health Act assessments.
- 2006– Book royalty income from Routledge of Taylor Francis Group, previously Lawrence Erlbaum Associates.
- 2002– Software royalty income from the sales of Whisker and related software by licensee companies (Cambridge Cognition Ltd, 2002–2004; Campden Instruments Ltd, 2004–; Campden is owned by the Lafayette Instrument Company Inc.). Royalties are paid via companies owned by the University of Cambridge (Cambridge University Technical Services Ltd; Cambridge Enterprise) to the University, the Department of Experimental Psychology, myself, and my co-author. I have also been paid as a consultant to Campden Instruments Ltd (2004–) and the University of Cambridge (2009–) regarding these software products. End users of our software include universities, companies, and government research organizations.

Professional societies

- 2012– Member, British Association for Psychopharmacology.
- 2010– Member, Royal College of Psychiatrists.
- 2007– Member, Royal College of Physicians of London.
- 2007– Member, British Neuropsychiatry Association.
- 2007– Chartered Psychologist; Member (2007–2011) and Associate Fellow (2011–), British Psychological Society.
- 2006– Chartered Biologist; Member, Institute of Biology (2006–2009), subsequently Society of Biology (2009–2015), subsequently Royal Society of Biology (2015–).
- 2005– Associate (2005–2007), Member (2008–2013) and Fellow (2013–), Institute of Biomedical Science.
- 2005– Member, British Medical Association.
- 2003– Member, New York Academy of Sciences.
- 2001– Medical practitioner registered with the UK General Medical Council. Provisional registration 2001; full registration 2002; licensed to practise from the introduction of licensing (2009–); registration #6 029 215.
- 2000– Member, Society for Neuroscience.
- 2000– Member, British Neuroscience Association.
- 1999– Member, European Behavioural Pharmacology Society.
- 1996– Member, Medical Protection Society.