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## Qualifications

2015	<b>Certificate of Completion of Training</b> , general adult and liaison psychiatry	
2009	<b>Membership of the Royal College of Psychiatrists</b>	All parts at first attempt.
2007	<b>Membership of the Royal Colleges of Physicians of the United Kingdom</b>	All parts at first attempt.
2006	<b>Doctor of Medicine</b> , University of Cambridge	No corrections.
2001	<b>Doctor of Philosophy</b> , Experimental Psychology, University of Cambridge	No corrections.
2001	<b>Bachelor of Medicine &amp; Bachelor of Surgery</b> (*), University of Cambridge	(*) Distinction
2000	<b>Master of Arts</b> , University of Cambridge	
1996	<b>Bachelor of Arts</b> (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	<b>S-Level</b> : Physics (1: distinction), Chemistry (1: distinction)	
1992	<b>A-Level</b> : Physics (A), Chemistry (A), Biology (A), Further Mathematics (A)	
1991	<b>A-Level</b> : Mathematics (A) (self-taught)	

## Clinical status

Clinically qualified; clinically active.

## Current positions

- 2021–present **Associate Professor of Clinical Informatics**, Department of Psychiatry, University of Cambridge.  
2016–present **Honorary consultant liaison psychiatrist**, Cambridgeshire & Peterborough NHS Foundation Trust (CPFT) and Cambridge University Hospitals NHS Foundation Trust.

## Previous positions

- 2016–2021 **University Lecturer in Clinical Informatics**, Department of Psychiatry, University of Cambridge (unestablished, 2016–2021; established/tenured, 2021).  
2011–2016 **Clinical Lecturer in Psychiatry**, University of Cambridge.  
2010–2016 **Honorary specialist registrar in general adult/liaison psychiatry**, CPFT.
  - 2015–2016: 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.
  - 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.
  - 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**.
  - 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** (1992–3), South Kent College, Folkestone; **clerk** (1992), Saga Services Ltd, Folkestone; freelance **systems consultant** (1994–5) and **communications programmer** (1989–90), inc. for Mencap, South East Kent Doctors On Call Ltd, H. V. Wooding Ltd, Shepway Community Health Care Trust.


## Education


- 1980–1985 Sandgate Primary School, Folkestone.
- 1985–1992 The Harvey Grammar School, Folkestone.
- 1993–2001 St John's College, Cambridge.


## Prizes and distinctions

- 1994 & 1995 Wright Prize (for Medical & Veterinary Sciences), St John's College.
- 1996 Parke–Davis Prize for Neuroscience, University of Cambridge.
- 1996 Northcott Prize (for Neuroscience) and Hughes Year Prize, St John's College.
- 2001 Peter Brook Award for Psychiatric Research, University of Cambridge.
- 2001 College Prize (for Medicine), St John's College, Cambridge.
- 2002 British Psychological Society Award for Outstanding Doctoral Research Contributions to Psychology.
- 2003 Finalist, international Eppendorf & Science Prize for Neurobiology.
- 2007 Ralph Noble Prize (for MD dissertation in psychiatry), University of Cambridge.
- 2007 Sir Lionel Whitby Medal & Prize (for MD of exceptional merit), University of Cambridge.
- 2013 Fellow, Institute of Biomedical Science.
- 2014 Higher Psychiatric Trainee of the Year, Royal College of Psychiatrists.
- 2019– NHS Clinical Excellence Award.
- 2020 Fellow, Faculty of Clinical Informatics.
- 2021 Fellow, Royal Society of Biology.
- 2021 Fellow, Royal College of Psychiatrists.

## Publications

 <https://orcid.org/0000-0002-8751-5167>

PMID: PubMed identifier. DOI: digital object identifier. Underlined text:  hyperlink.

† indicates ≥100 citations (ISI); ‡ ≥300 citations (ISI citation classic); ◆ ≥1,000 citations;  international press coverage.



## Books

1. **Cardinal RN**, Aitken MRF (2006). *ANOVA for the Behavioural Sciences Researcher*. Lawrence Erlbaum Associates, Mahwah, NJ, USA (later Routledge, later Psychology Press). DOI: [10.4324/9780203763933](https://doi.org/10.4324/9780203763933).
2. **Cardinal RN**, Bullmore ET (2011). *The Diagnosis of Psychosis*. Cambridge University Press, Cambridge, UK. DOI: [10.1017/CBO9780511686917](https://doi.org/10.1017/CBO9780511686917).

## Primary data papers and review articles

2000

1. Everitt BJ, **Cardinal RN**, Hall J, Parkinson JA, Robbins TW (2000). 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. ISBN [0198505019](#).

- † 2. Parkinson JA, **Cardinal RN**, Everitt BJ (2000). Limbic cortical-ventral striatal systems underlying appetitive conditioning. *Progress in Brain Research* 126: 263–285. PMID [11105652](#).
- † 3. **Cardinal RN**, Robbins TW, Everitt BJ (2000). 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. PMID [11140328](#).

2001

- † 4. Rahman S, Sahakian BJ, **Cardinal RN**, Rogers RD, Robbins TW (2001). Decision-making and neuropsychiatry. *Trends in Cognitive Sciences* 5: 271–277. PMID [11390298](#).
- ‡ 5. **Cardinal RN**, Pennicott DR, Sugathapala CL, Robbins TW, Everitt BJ (2001). Impulsive choice induced in rats by lesions of the nucleus accumbens core. *Science* 292: 2499–2501. PMID [11375482](#).
- † 6. Dalley JW, McGaughy J, O’Connell MT, **Cardinal RN**, Levita L, Robbins TW (2001). 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. PMID [11425918](#).
- † 7. Di Ciano P, **Cardinal RN**, Cowell RA, Little SJ, Everitt BJ (2001). 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. PMID [11717381](#).

2002

- † 8. **Cardinal RN**, Parkinson JA, Lachenal G, Halkerston KM, Rudarakanchana N, Hall J, Morrison CH, Howes SR, Robbins TW, Everitt BJ (2002). 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. PMID [12148923](#).
- ◆ 9. **Cardinal RN**, Parkinson JA, Hall J, Everitt BJ (2002). Emotion and motivation: the role of the amygdala, ventral striatum, and prefrontal cortex. *Neuroscience and Biobehavioral Reviews* 26: 321–352. PMID [12034134](#).
- 10. **Cardinal RN**, Daw ND, Robbins TW, Everitt BJ (2002). Local analysis of behaviour in the adjusting-delay task for assessing choice of delayed reinforcement. *Neural Networks* 15: 617–634. PMID [12371516](#).
- † 11. Parkinson JA, Dalley JW, **Cardinal RN**, Bamford A, Fenhert B, Lachenal G, Rudarakanchana N, Halkerston KM, Robbins TW, Everitt BJ (2002). 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. PMID [12445721](#).

2003

- 12. **Cardinal RN**, Robbins TW, Everitt BJ (2003). 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. DOI: [10.1016/B978-008044056-9/50048-8](#).
- † 13. Everitt BJ, **Cardinal RN**, Parkinson JA, Robbins TW (2003). Appetitive behavior: the impact of amygdala-dependent mechanisms of emotional learning. *Annals of the New York Academy of Sciences* 985: 233–250. PMID [12724162](#).
- 14. **Cardinal RN**, Parkinson JA, Djafari Marbini H, Toner AJ, Bussey TJ, Robbins TW, Everitt BJ (2003). Role of the anterior cingulate cortex in the control over behavior by Pavlovian conditioned stimuli in rats. *Behavioral Neuroscience* 117: 566–587. PMID [12802885](#).
- 15. **Cardinal RN**, Parkinson JA, Hall J, Everitt BJ (2003). The contribution of the amygdala, ventral striatum, and prefrontal cortex to emotion and motivated behaviour. *International Congress Series* 1250: 347–370. DOI [10.1016/S0531-5131\(03\)01013-6](#). In: Ono T, Matsumoto G, Llinás RR, Berthoz A, Norgren R, Nishijo H, Tamura R (eds), *Cognition and Emotion in the Brain*. Elsevier, Amsterdam.

2004

- † 16. **Cardinal RN**, Winstanley CA, Robbins TW, Everitt BJ (2004). Limbic corticostriatal systems and delayed reinforcement. *Annals of the New York Academy of Sciences* 1021: 33–50. PMID [15251872](#).
- † 17. **Cardinal RN**, Everitt BJ (2004). Neural and psychological mechanisms underlying appetitive learning: links to drug addiction. *Current Opinion in Neurobiology* 14(2): 156–162. PMID [15082319](#).
- ‡ 18. Dalley JW, **Cardinal RN**, Robbins TW (2004). Prefrontal executive and cognitive functions in rodents: neural and neurochemical substrates. *Neuroscience and Biobehavioral Reviews* 28: 771–784. PMID [15555683](#).
- ‡ 19. Winstanley CA, Theobald DEH, **Cardinal RN**, Robbins TW (2004). Contrasting roles of basolateral amygdala and orbitofrontal cortex in impulsive choice. *Journal of Neuroscience* 24: 4718–4722. PMID [15152031](#).
- † 20. Dalley JW, Theobald DE, Bouger P, Chudasama Y, **Cardinal RN**, Robbins TW (2004). 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. PMID [15084496](#).

2005

21. **Cardinal RN**, Cheung THC (2005). Nucleus accumbens core lesions retard instrumental learning and performance with delayed reinforcement in the rat. *BMC Neuroscience* 6: 9. PMID [15691387](#).
22. Cheung THC, **Cardinal RN** (2005). Hippocampal lesions facilitate instrumental learning with delayed reinforcement but induce impulsive choice in rats. *BMC Neuroscience* 6: 36. PMID [15892889](#).
- † 23. **Cardinal RN**, Howes NJ (2005). Effects of lesions of the nucleus accumbens core on choice between small certain rewards and large uncertain rewards in rats. *BMC Neuroscience* 6: 37. PMID [15921529](#).
- † 24. Winstanley CA, Theobald DEH, Dalley JW, **Cardinal RN**, Robbins TW (2005). Double dissociation between serotonergic and dopaminergic modulation of medial prefrontal and orbitofrontal cortex during a test of impulsive choice. *Cerebral Cortex* 16: 106–114. PMID [15829733](#).

2006

25. Robbins TW, **Cardinal RN**, Di Ciano P, Halligan PWG, Hellems KGC, Lee JCL, Everitt BJ (2006). *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. DOI: [10.1016/B978-012370624-9/50006-2](#).
- † 26. **Cardinal RN** (2006). Neural systems implicated in delayed and probabilistic reinforcement. *Neural Networks* 19: 1277–1301. PMID [16938431](#). [Neural Networks *Most Cited Article 2006–2010* award, Elsevier.]
27. Chamberlain SR, Müller U, Deakin JB, Corlett PR, Dowson J, **Cardinal RN**, Aitken MRF, Robbins TW, Sahakian BJ (2006). Lack of deleterious effects of buspirone on cognition in healthy male volunteers. *Journal of Psychopharmacology* 21: 210–215. PMID [17329302](#).

2007

28. 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 (2007). Explaining the escalation of drug use in substance dependence: Models and appropriate animal laboratory tests. *Pharmacology* 80: 65–119. PMID [17570954](#).

2009

29. **Cardinal RN**, Gregory CA (2009). Osteomalacia and vitamin D deficiency in a psychiatric rehabilitation unit: case report and survey. *BMC Research Notes* 2: 82. PMID [19426538](#).
30. **Cardinal RN**, Shah DN, Edwards CJ, Hughes GRV, Fernández-Egea E (2009). Psychosis and catatonia as a first presentation of antiphospholipid syndrome. *British Journal of Psychiatry* 195: 272. PMID [19721128](#).

2010

31. **Cardinal RN** (2010). Analysis of variance. In: Weiner IB, Craighead WE (eds), *Corsini Encyclopedia of Psychology* (fourth edition), pp. 92–98. John Wiley & Sons, Hoboken, New Jersey. DOI: [10.1002/9780470479216.corpsy0054](#).
32. **Cardinal RN**, Everitt BJ (2010). 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. DOI: [10.1016/B978-0-08-045396-5.00167-6](#).
33. **Cardinal RN**, Aitken MRF (2010). Whisker: a client-server high-performance multimedia research control system. *Behavior Research Methods* 42: 1059–1071. PMID [21139173](#).

2013

34. Gillan CM, Morein-Zamir S, Kasar M, Fineberg NA, Sule A, Sahakian BJ, **Cardinal RN**, Robbins TW (2013). Counterfactual processing of economic action–outcome alternatives in obsessive–compulsive disorder: Further evidence of impaired goal-directed behavior. *Biological Psychiatry* 75: 639–646. PMID [23452663](#).

2014

35. Clarke HF\*, **Cardinal RN\***, Rygula R, Hong YT, Fryer TD, Sawiak SJ, Ferrari V, Cockcroft G, Aigbirhio FI, Robbins TW, Roberts AC (2014). Orbitofrontal dopamine depletion up-regulates caudate dopamine and produces behavioral changes akin to schizophrenia. *Journal of Neuroscience* 34: 7663–7676. PMID [24872570](#). (\*Joint first authors.)
36. Rygula R, Clarke HF, **Cardinal RN**, Cockcroft GJ, Xia J, Roberts TW, Roberts AC (2014). 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. PMID [24879752](#).

2015

37. Barker V, Romaniuk L, **Cardinal RN**, Pope M, Nicol K, Hall J (2015). Impulsivity in borderline personality disorder. *Psychological Medicine* 45: 1955–1964. PMID [25600066](#).

38. Brydges NM, Holmes MC, **Cardinal RN**, Harris AP, Hall J (2015). Early life stress produces compulsive-like behavior in females. *Behavioral Neuroscience* 129: 300–308. PMID [26030429](#).
39. Weed MR, Bookbinder M, Polino J, Keavy D, **Cardinal RN**, Simmermacher-Mayer J, Cometa FL, King D, Thangathirupathy S, Macor JE, Bristow LJ (2015). Negative allosteric modulators selective for the NR2b subtype of the NMDA receptor impairs cognition in multiple domains. *Neuropsychopharmacology* 41: 568–577. PMID [26105137](#).
40. **Cardinal RN**, Savulich G, Mann LM, Fernández-Egea E (2015). Association between antipsychotic/antidepressant drug treatments and hospital admissions in schizophrenia assessed using a mental health case register. *npj Schizophrenia* 1: 15035. PMID [27336041](#).

2017

41. **Cardinal RN** (2017). Clinical records anonymisation and text extraction (CRATE): an open-source software system. *BMC Medical Informatics and Decision Making* 17: 50. PMID [28441940](#).
42. Wallis CU, **Cardinal RN**, Alexander L, Roberts AC, Clarke HF (2017). Opposing roles of primate areas 25 and 32 and their putative rodent homologs in the regulation of negative emotion. *Proceedings of the National Academy of Sciences of the USA* 114: E4075–E4084. PMID [28461477](#).
43. Giuliano C, Peña-Oliver Y, Goodlett CR, **Cardinal RN**, Robbins TW, Bullmore ET, Belin D, Everitt BJ (2017). Evidence for a long-lasting compulsive alcohol seeking phenotype in rats. *Neuropsychopharmacology* 43: 728–738. PMID [28553834](#).
44. Price A, Farooq R, Yuan J-M, Menon VB, **Cardinal RN**, O'Brien JT (2017). Mortality in dementia with Lewy bodies compared to Alzheimer's dementia: a retrospective naturalistic cohort study. *BMJ Open* 7: e017504. PMID [29101136](#).

2018

45. O'Callaghan C, Vaghi MM, Brummerloh B, **Cardinal RN**, Robbins TW (2018). Impaired awareness of action–outcome contingency and causality during healthy ageing and following ventromedial prefrontal cortex lesions. *Neuropsychologia* 128: 282–289. PMID [29355648](#).
46. Osimo EF, **Cardinal RN**, Jones PB, Khandaker GM (2018). Prevalence and correlates of low-grade systemic inflammation in adult psychiatric inpatients: an electronic health record-based study. *Psychoneuroendocrinology* 91: 226–234. PMID [29544672](#).
47. Skandali N, Rowe J, Voon V, Deakin JB, **Cardinal RN**, Cormack F, Regenthal R, Chamberlain SR, Robbins TW, Sahakian BJ (2018). Dissociable effects of acute SSRI (escitalopram) administration on executive, learning and emotional functions in healthy humans. *Neuropsychopharmacology* 43: 2645–2651. PMID [30305705](#).
48. Jalal B, Bruhl A, O'Callaghan C, Piercy T, **Cardinal RN**, Ramachandran VS, Sahakian BJ (2018). Novel smartphone interventions improve cognitive function and obsessive–compulsive disorder symptoms in individuals with contamination fears. *Scientific Reports* 8: 14923. PMID [30353111](#).
49. Vaghi MM, **Cardinal RN**, Apergis-Schoute AM, Fineberg NA, Sule A, Robbins TW (2018). Action–outcome knowledge dissociates from behavior in obsessive–compulsive disorder following contingency degradation. *Biological Psychiatry: Cognitive Neuroscience and Neuroimaging* 4: 200–209. PMID [30545754](#).

2019

50. Zeredo JL, Leung SKQ, Wallis CU, Alexander L, Cockcroft G, Santangelo AM, Xia J, Shiba Y, Dalley JW, **Cardinal RN**, Roberts AC, Clarke HF (2019). Glutamate within the marmoset anterior hippocampus interacts with area 25 to regulate the behavioral and cardiovascular correlates of high-trait anxiety. *Journal of Neuroscience* 39: 3094–3107. PMID [30718320](#).
51. Moylett S, Price AC, **Cardinal RN**, Aarsland D, Mueller C, Stewart R, O'Brien JT (2019). Clinical presentation, diagnostic features, and mortality in dementia with Lewy bodies. *Journal of Alzheimer's Disease* 67: 995–1005. PMID [30776008](#).
52. Wallis CU, Cockcroft GJ, **Cardinal RN**, Roberts AC, Clarke HF (2019). Hippocampal interaction with area 25, but not area 32, regulates marmoset approach–avoidance behavior. *Cerebral Cortex* 29: 4818–4830. PMID [30796800](#).
53. Alsö J, Phillips BU, Sala Bayo J, Nilsson SRO, Calafat-Pla TC, Rizwand A, Plumbridge J, López-Cruz L, Dalley JW, **Cardinal RN**, Mar AC, Robbins TW (2019). Dopamine D2-like receptor stimulation selectively blocks learning from losses in visual and spatial reversal learning in the rat: behavioural and computational evidence. *Psychopharmacology* 236: 2307–2323. PMID [31218428](#).
54. Robbins TW, **Cardinal RN** (2019). Computational psychopharmacology: a translational and pragmatic approach. *Psychopharmacology* 236: 2295–2305. PMID [31273400](#).
55. Kanen JW, Ersche KD, Fineberg NA, Robbins TW, **Cardinal RN** (2019). Computational modelling reveals contrasting effects on reinforcement learning and cognitive flexibility in stimulant dependence and obsessive–compulsive disorder: remediating effects of dopaminergic D2/3 receptor agents. *Psychopharmacology* 236: 2337–2358. PMID [31324936](#).



2020

56. Lim TV, **Cardinal RN**, Savulich GJ, Moustafa AA, Robbins TW, Ersche KD (2019). Impairments in reinforcement learning do not explain enhanced habit formation in cocaine use disorder. *Psychopharmacology* 236: 2359–2371. PMID [31372665](#).
57. Fernández-Egea E, Walker R, Ziauddeen H, **Cardinal RN**, Bullmore ET (2020). Birth weight, family history of diabetes and diabetes onset in schizophrenia. *BMJ Open Diabetes Research & Care* 8: e001036. PMID [32049635](#).
58. Kanen JW, Arntz FE, Yellowlees R, **Cardinal RN**, Price AC, Christmas DM, Sahakian BJ, Apergis-Schoute AM, Robbins TW (2020). Probabilistic reversal learning under acute tryptophan depletion in healthy humans: a conventional analysis. *Journal of Psychopharmacology* 34: 580–583. PMID [32066325](#).
59. Ive J, Viani N, Kam J, Yin L, Verma S, Puntis S, **Cardinal RN**, Roberts A, Stewart R, Velupillai S (2020). Generation and evaluation of artificial mental health records for natural language processing. *npj Digital Medicine* 3: 69. PMID [32435697](#).
60. Rose E\*, Chen S\*, Turrion C, Jenkins C, **Cardinal RN**, Fernández-Egea E (2020). Causes of death in clozapine-treated patients in a catchment area: a 10-year retrospective case-control study. *European Neuropsychopharmacology* 36: 160–166. PMID [32546415](#). (\*Joint first authors.) [Open Access: DOI [10.17863/CAM.52877](#).]
61. Osimo EF, Perry BI, **Cardinal RN**, Lynall M-E, Lewis JR, Kudchadkar A, Murray G, Perez J, Jones PB, Khandaker GM (2020). Inflammatory and cardiometabolic markers at presentation with first episode psychosis and long-term clinical outcomes: a longitudinal study using electronic health records. *Brain, Behavior, and Immunity* 91: 117–127. PMID [32950620](#).
62. Chen S, Jones PB, Underwood BR, Moore A, Bullmore ET, Banerjee S, Osimo EF, Deakin JB, Hatfield CF, Thompson FJ, Artingstall JD, Slann MP, Lewis JR, **Cardinal RN** (2020). The early impact of COVID-19 on mental health and community physical health services and their patients' mortality in Cambridgeshire and Peterborough, UK. *Journal of Psychiatric Research* 131: 244–254. PMID [33035957](#). [Preprint on [SSRN](#).]
63. Wang Z, Ive J, Moylett S, Mueller C, **Cardinal RN**, Velupillai S, O'Brien J, Stewart R (2020). Distinguishing between dementia with Lewy bodies (DLB) and Alzheimer's disease (AD) using mental health records: a classification approach. In: Rumshishky A, Roberts K, Bethard S, Naumann T (eds.), *Proceedings of the 3<sup>rd</sup> Clinical Natural Language Processing Workshop*, pp. 168–177. DOI [10.18653/v1/2020.clinicalnlp-1.19](#).
64. Kershenbaum AD, **Cardinal RN**, Chen S, Underwood B, Seyedsalehi A, Lewis JR, Rubinsztein JS (2020). Investigation of risk of dementia diagnosis and death in patients in older people's secondary care mental health services. *International Journal of Geriatric Psychiatry* 36: 573–582. PMID [33113255](#).
65. Chen S, She R, Qin P, Kershenbaum AD, Fernández-Egea E, Nelder JR, Ma C, Lewis JR, Wang C, **Cardinal RN** (2020). The medium-term impact of COVID-19 lockdown on referrals to secondary care mental health services: a controlled interrupted time series study. *Frontiers in Psychiatry* 11: 585915. PMID [33324258](#).

2021

66. Kanen JW, Arntz FE, Yellowlees R, Price AC, Christmas DM, Apergis-Schoute AM, Sahakian BJ, **Cardinal RN**, Robbins TW (2021). Effect of tryptophan depletion on conditioned threat memory expression: role of intolerance of uncertainty. *Biological Psychiatry: Cognitive Neuroscience and Neuroimaging* 6: 590–598. PMID [33631385](#). [Preprint on [bioRxiv](#).]
67. Bhardwaj A, Moore A, **Cardinal RN**, Bradley C, Cross L, Ford TJ (2021). Survey of CAMHS clinicians about their experience of remote working: brief report. *BJPsych Open* 7: e34. PMID [33436136](#).
68. Kanen JW, Arntz FE, Yellowlees R, **Cardinal RN**, Price AC, Christmas DM, Apergis-Schoute AM, Sahakian BJ, Robbins TW (2021). Serotonin depletion amplifies distinct human social emotions as a function of individual differences in personality. *Translational Psychiatry* 11: 81. PMID [33518708](#). [Preprint on [bioRxiv](#).]
69. **Cardinal RN**, Meiser-Stedman CE, Christmas DM, Price AC, Denman C, Underwood BR, Chen S, Banerjee S, White SR, Su L, Ford TJ, Chamberlain SR, Walsh CM (2021). Simulating a community mental health service during the COVID-19 pandemic: effects of clinician–clinician encounters, clinician–patient–family encounters, symptom-triggered protective behaviour, and household clustering. *Frontiers in Psychiatry* 12: 620842. PMID [33716821](#). [Preprint on [medRxiv](#).]
70. Alabaf S, Kirkpatrick B, Chen S, **Cardinal RN**, Fernández-Egea E (2021). Early versus late risk factors for deficit and nondeficit schizophrenia. *Revista de Psiquiatría y Salud Mental* 15: 38–46. PMID [33813046](#).
71. Giuliano C, Puaud M, **Cardinal RN**, Belin D\*, Everitt BJ\* (2021). Individual differences in the engagement of habitual control over alcohol seeking predicts the development of compulsive alcohol seeking and drinking. *Addiction Biology* 26: e13041. PMID [33955649](#). (\*Joint last authors.) [Preprint on [bioRxiv](#).]
72. Bakolis I, Stewart R, Baldwin DS, Beestock J, Bibby P, Broadbent M, **Cardinal RN**, Chen S, Chinnasamy K, Cipriani A, Douglas S, Horner P, Jackson C, John A, Joyce DW, Lee SC, Lewis JR, McIntosh A, Nixon N, Osborn DPJ, Phiri P, Rathod S, Smith T, Sokal R, Waller R, Landau S (2021). Changes in daily mental health service use and mortality at the commencement and lifting of COVID-19 'lockdown' policy in ten UK sites: a regression discontinuity in time design. *BMJ Open* 11: e049721. PMID [34039579](#).

73. Burrin C, Daniels NF, **Cardinal RN**, Hayhurst C, Christmas D, Zimbron J (2021). Iatrogenic complications of compulsory treatment in a patient with personality disorder and self-harm. *Case Reports in Psychiatry* 2021: 6615723. PMID [34136300](#).
74. Fernández-Egea E, Chen S, Jenkins C, Turrion C, Mitchell SP, Dodwell DJF, Mann LM, Deakin JB, Syed ZH, Hafizi S, Zimbron J, Praseedom AS, **Cardinal RN** (2021). The effect of clozapine on self-reported duration of sleep and its interaction with other medications: a 5-year naturalistic study. *Journal of Clinical Psychopharmacology* 41: 534–539. PMID [34519455](#).
75. Duan LY, Horst NK, Cranmore SAW, Horiguchi N, **Cardinal RN**, Roberts AC, Robbins TW (2021). Controlling one's world: identification of sub-regions of primate PFC underlying goal-directed behaviour. *Neuron* 109: 2485–2498. PMID [34171290](#). [Preprint on [bioRxiv](#). Comment: PMID [34352212](#).]
76. Lim TV, **Cardinal RN**, Bullmore ET, Robbins TW, Ersche KD (2021). Impaired learning from negative feedback in stimulant use disorder: dopaminergic modulation. *International Journal of Neuropsychopharmacology* 24: 867–878. PMID [34197589](#).
77. Chen S, Jones PB, Underwood BR, Fernández-Egea E, Qin P, Lewis JR, **Cardinal RN** (2021). Risk factors for excess deaths during lockdown among older users of secondary care mental health services without confirmed COVID-19: A retrospective cohort study. *International Journal of Geriatric Psychiatry* 36: 1899–1907. PMID [34382242](#). [Preprint on [SSRN](#).]
78. Kanen JW, Apergis-Schoute AM, Yellowlees R, Arntz FE, van der Flier FE, Price AC, **Cardinal RN**, Christmas DM, Clark L, Sahakian BJ, Crockett MJ, Robbins TW (2021). Serotonin depletion impairs both Pavlovian and instrumental reversal learning in healthy humans. *Molecular Psychiatry* 26: 7200. PMID [34429517](#). [Preprint on [bioRxiv](#).]
79. Chen S, **Cardinal RN** (2021). Accessibility and efficiency of mental health services, United Kingdom of Great Britain and Northern Ireland. *Bulletin of the World Health Organization* 99: 674–679. PMID [34475604](#).
80. Chen S, Fernández-Egea E, Jones PB, Lewis JR, **Cardinal RN** (2021). Longer-term mortality following SARS-CoV-2 infection in patients with severe mental illness: a retrospective case-matched study. *BjPsych Open* 7: e201. PMID [34745650](#).
81. Chen S, Aruldass AR, **Cardinal RN** (2021). Mental health outcomes after SARS-CoV-2 vaccination in the United States: a national cross-sectional study. *Journal of Affective Disorders* 298: 396–399. PMID [34774648](#).
82. **Cardinal RN**, Burchell M (2021). The Cambridge cognitive and psychiatric assessment kit (CamCOPS): a secure open-source client-server system for mobile research and clinical data capture. *Frontiers in Psychiatry* 12: 578298. PMID: [34867492](#).
83. Banerjee S, Liò P, Jones PB, **Cardinal RN** (2021). A human-interpretable machine learning approach to predict mortality in severe mental illnesses. *npj Schizophrenia* 7: 60. PMID [34880262](#). [Preprint on [medRxiv](#).]
- 2022
84. Parkin K, Chen S, Biria M, Plaistow J, Beckwith H, Jarratt-Barnham I, Segarra N, Worbe Y, Fineberg NA, **Cardinal RN**, Robbins TW, Fernández-Egea E (2022). Clozapine-related obsessive-compulsive symptoms and their impact on wellbeing: a naturalistic longitudinal study. *Psychological Medicine*. PMID [35469587](#). [Preprint on [Research Square](#).]
85. Chen S, Jones LA, Jiang S, Jin H, Dong D, Chen X, Wang D, Zhang Y, Xiang L, Zhu A, **Cardinal RN** (2022). Difficulty and help with activities of daily living among older adults living alone during the COVID-19 pandemic: a multi-country population-based study. *BMJ Geriatrics* 22: 181. PMID: [35246064](#).
86. Chen S, Underwood BR, Jones PB, Lewis JR, **Cardinal RN** (2022). Association between lithium use and the incidence of dementia and its subtypes: a retrospective cohort study. *PLOS Medicine* 19: e1003941. PMID [35298477](#).
87. Chen S, Ford TJ, Jones PB, **Cardinal RN** (2022). Prevalence, progress, and subgroup disparities in pharmacological antidepressant treatment of those who screen positive for depressive disorders: a repetitive cross-sectional study in 19 European countries. *The Lancet Regional Health—Europe* 17: 100368. PMID [35373171](#).
88. Jones LA, Nelder JR, Fryer JM, Alsop PH, Geary MR, Prince M, **Cardinal RN** (2022). Public opinion on sharing data from health services for clinical and research purposes without explicit consent: an anonymous online survey in the UK. *BMJ Open* 12: e057579. PMID [35477868](#). [Preprint on [medRxiv](#).]
89. Banerjee S, Alsop PH, Jones LA, **Cardinal RN** (2022). Patient and public involvement to build trust in artificial intelligence: A framework, tools, and case studies. *Patterns* 3: 100506. [DOI: [10.1016/j.patter.2022.100506](#)]
90. Osimo EF, Lewis JR, **Cardinal RN\***, Khandaker GM\* (2022). Clozapine treatment and risk of COVID-19. *BjPsych Open* 8: e141. PMID [35815763](#). (\*Joint last authors.)

## Dissertations

partment of Experimental Psychology, University of Cambridge. Supervisors: Claire H. Bennett, Nicholas J. Mackintosh.

- 2001 **Cardinal RN** (2001). *Neuropsychology of reinforcement processes in the rat*. PhD thesis, University of Cambridge. DOI: [10.17863/CAM.16462](https://doi.org/10.17863/CAM.16462). Supervisor: Barry J. Everitt. Co-supervisor: Trevor W. Robbins. Examiners: Nicholas J. Mackintosh, Dai N. Stephens.
- 2006 **Cardinal RN** (2006). *Neural systems involved in delay and risk assessment in the rat*. MD thesis, University of Cambridge. DOI: [10.17863/CAM.16465](https://doi.org/10.17863/CAM.16465). Unsupervised. Examiners: Susan D. Iversen, Dai N. Stephens.

### Software for research and clinical practice: major packages

- 1997– **Cardinal RN**. *Assorted open-source code* at [pobox.com/~rudolf](https://pobox.com/~rudolf) and [github.com/RudolfCardinal](https://github.com/RudolfCardinal).
- 2000– **Cardinal RN**, Aitken MRF. *Whisker*. Behavioural research control software. 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. See [www.whiskercontrol.com](http://www.whiskercontrol.com) and PMID [21 139 173](https://pubmed.ncbi.nlm.nih.gov/21139173/).
- 2000– **Cardinal RN**. Behavioural clients for Whisker, including *MonkeyCantab*. See [www.whiskercontrol.com](http://www.whiskercontrol.com).
- 2013– **Cardinal RN**, Burchell M. *CamCOPS: the Cambridge Cognitive and Psychiatric Assessment Kit*. Open-source secure cross-platform software for cognitive and psychiatric assessment. See [camcops.readthedocs.io](http://camcops.readthedocs.io) and PMID [34 867 492](https://pubmed.ncbi.nlm.nih.gov/34867492/).
- 2015– **Cardinal RN**. *CRATE: clinical records anonymisation and text extraction*. Open-source cross-platform pipeline including anonymisation, a natural language processing framework, clinical and research query tools, and consent-to-contact management. See [crateanon.readthedocs.io](http://crateanon.readthedocs.io) and PMID [28 441 940](https://pubmed.ncbi.nlm.nih.gov/28441940/).

### Other publications, except abstracts

- 1998 **Cardinal RN** (1998). *Hooked on hash? Cambridge Medicine*.
- 2003 **Cardinal RN** (2003). *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 <https://www.sciencemag.org/site/feature/data/prizes/eppendorf/2003/2003winners.xhtml>.
- 2004 **Cardinal RN** (2004). *Waiting for better things*. *The Psychologist* 17: 684–687.
- 2005 **Cardinal RN** (2005). *Animal testing*. *The Times*, 1 September 2005, p. 18.
- 2005 **Cardinal RN** (2005). *Power to detect reduction in mortality [Rapid Response]*. *BMJ*, 4 September 2005; response to DOI: [10.1136/bmj.331.7515.468](https://doi.org/10.1136/bmj.331.7515.468).
- 2008 **Cardinal RN** (2008). *Calculation of cost-effectiveness of resident medical cover for psychiatric hospitals [Rapid Response]*. *BMJ*, 24 August 2008; response to DOI: [10.1136/bmj.39541.443611.80](https://doi.org/10.1136/bmj.39541.443611.80).
- 2012 **Cardinal RN** (2012). Book review. “Case Studies: Stahl’s Essential Psychopharmacology” by Stephen M. Stahl. *Acta Psychiatrica Scandinavica* 125: 504. DOI [10.1111/j.1600-0447.2012.01856.x](https://doi.org/10.1111/j.1600-0447.2012.01856.x).
- 2013 **Cardinal RN** (2013). *Steroid-induced psychosis*. *Crohn’s and Colitis UK* newsletter, summer: 7.

### Funding

#### Past

- 1997–2000 James Baird award, University of Cambridge School of Clinical Medicine.
- 1997–2000 **PhD studentship**: UK Medical Research Council (MRC) research studentship.
- 2002–2007 **Lectureship**: UK MRC Lectureship in Neuroscience (Behavioural and Clinical Neuroscience Centre/Institute; taken until 2005).
- 2007–2010 **Fellowship**: UK NHS National Institute for Health Research (NIHR) Academic Clinical Fellowship in Psychiatry (ACF-2007-14-006).
- 2010–2014 **Fellowship**: Wellcome Trust (WT) Postdoctoral Fellowship for MB/PhD Graduates (091 998/Z/10/Z). *Developing models of thalamocortical unsupervised attentional selection and competitive learning*. £194k.
- 2010–2015 Faculty: MRC/WT Behavioural and Clinical Neuroscience Institute (principal investigators [PIs]: Trevor W. Robbins & Edward T. Bullmore; MRC [G1 000 183](https://doi.org/10.1002/183), WT [093 875/Z/10/Z](https://doi.org/10.1002/093875)). £5M.
- 2014–2021 Collaborator: WT Senior Investigator Award in Biomedical Science (PI: Trevor W. Robbins, [104 631/Z/14/Z](https://doi.org/10.104631)). *Fronto-striatal systems in impulsive–compulsive disorders*. £2.9M.
- 2016–2021 Collaborator: WT Investigator Award in Biomedical Science (PI: Angela C. Roberts; [108 089/Z/15/Z](https://doi.org/10.108089)). *Fractionating the functions of primate ventromedial prefrontal cortex of relevance to depression*. £2M.
- 2017–2022 Collaborator: Alzheimer’s Society Project Grant (PI: John T. O’Brien; 326/AS-PG-16-006). *Using medical records to diagnose dementia with Lewy bodies*. £399k.



- 2018–2019 Collaborator: UK Engineering and Physical Sciences Research Council (EPSRC) Healtex award (PI: Julia Ive). *Towards shareable data in clinical natural language processing: generating synthetic electronic health records*. £25k.
- 2018–2021 **Principal investigator:** MRC Mental Health Data Pathfinder award (University of Cambridge, CPFT; [MC\\_PC\\_17213](#)). £1.5M. [[Dimensions](#)]
- 2019–2020 Collaborator: EPSRC Healtex award (PI: Natalia Viani). *Modelling and extracting disease progression from multiple patient documents: a study of psychosis symptom trajectories*. £20k.
- 2020–2021 **Co-investigator:** MRC, UK Arts and Humanities Research Council (AHRC), and UK Economic and Social Research Council (ESRC) “Adolescence, Mental Health and the Developing Mind” Engagement Award (PI: Anna Moore; [MR/T046430/1](#)). *Towards early identification of adolescent mental health problems (TIMELY)*. £101k. [[Dimensions](#)]
- 2021–2021 **Principal investigator:** NIHR Cambridge Biomedical Research Centre (BRC) project (part of [BRC-1215-20014](#)). *Development of CamCOPS/CRATE for broader clinical/research use*. £23k.
- 2021–2021 **Principal investigator:** NIHR Cambridge BRC project (part of [BRC-1215-20014](#)). *Patient/public involvement for underrepresented views on data use and for Cambridge BRC data linkage*. £19k.
- 2021–2021 **Principal investigator:** CPFT Research & Development Strategic Funding award. *Improving mental health data use through patient/public involvement and software development*. £20k.
- 2021–2022 **Co-investigator:** NIHR Artificial Intelligence for Multiple Long-Term Conditions award (PIs: Deepti Gurdasani & Golam Khandaker; [NIHR202646](#)). *Using deep learning approaches to examine serious mental illness and physical multimorbidity across the life-course: from mechanisms towards novel interventions*. £117k.
- 2021–2022 **Co-investigator:** EPSRC/Alan Turing Institute “Towards Turing 2” grant (PI: Anna Moore; T2-15). *TIMELY: towards early identification of child and adolescent mental health problems*. £251k.
- 2022–2022 **Co-investigator:** MRC/HDR UK Data and Analytics Research Environments (DARE) UK Sprint Exemplar grant (PI: Anna Moore; [MC\\_PC\\_21025](#)). *FAIR TREATMENT: Federated analytics and AI Research across TREs [trusted research environments] for AdolescenT MENTAL health*. £343k.
- Current*
- 2021–2024 **Co-investigator:** MRC/Health Data Research UK (HDR UK) Mental Health Data Hub (PI: Ann John; [MR/W014386/1](#)). *DATAMIND – Data Hub for Mental Health Informatics Research Development*. £2M.
- 2021–2026 Collaborator: MRC Programme Grant (PI: Angela C. Roberts; [MR/V033492/1](#)). *Psychological, pharmacological and developmental insights into the prefrontal circuits underlying threat regulation and negative bias in marmosets*. £2.6M.
- 2022– Collaborator: WT Investigator Award (PI: Angela Roberts; 224432/Z/21/Z). *Functional heterogeneity in the prefrontal cortex of adult and developing marmosets: insight into the individual variation in depression and its symptoms*.
- 2022–2026 **Co-investigator:** NIHR Health Services and Delivery Research Programme grant (PI: Robbie Duschinsky; NIHR134922). *What CAMHS interventions predict positive outcomes for which young people with a social worker: a mixed-methods study of clinical support and cost-effectiveness utilising linked operational data*. £1.3M.

## Research supervision

- Undergrad. Undergraduate (Part II) research projects:
- 1999–2000: David R. Pennicott,<sup>1</sup> C. Lakmali Sugathapala.<sup>1</sup> *Role of anterior cingulate cortex in choice involving delayed reinforcement*.
  - 1999–2000: Andrew J. Toner,<sup>1</sup> Hosnieh Djafari-Marbini.<sup>1</sup> *Role of anterior cingulate cortex in Pavlovian conditioning*.
  - 2002–2003: Laura C.E. Sorensen,<sup>1</sup> Aidyn Kussainov,<sup>1</sup> Shahzad M. Alikhan,<sup>1</sup> Rosemary A.B. Marsh.<sup>1</sup> *Effects of buspirone on human cognition*.
  - 2002–2003: Timothy H.C. Cheung.<sup>1</sup> *Effect of nucleus accumbens core lesions on free-operant learning with delayed reinforcement*.
  - 2003–2004: Minh L. Lam,<sup>1</sup> Ranbir S. Sandhu.<sup>1</sup> *Effects of guanfacine on human cognition*.
  - 2003–2004: Nathan J. Howes.<sup>1</sup> *Effects of nucleus accumbens core lesions on choice involving uncertain reward*.
  - 2004–2005: Christopher Burnie,<sup>1</sup> Louis G.S. Verdi,<sup>1</sup> Steven T. Romans.<sup>1</sup> *Developing an audiovisual intradimensional/extradimensional set-shifting task for the rat*.
- Master’s Master’s degrees by research, or equivalent:
- 1999, Maîtrise: Guillaume Lachenal.<sup>1,4</sup> *Effect of limbic lesions on autoshaping performance*.
  - 2003–2004, MPhil: Timothy H.C. Cheung.<sup>1</sup> *Contributions of the ventral striatum and the hippocampus to the processing of delayed reinforcement in the rat*.
  - 2020–2021, MPhil (as advisor): Lukas Cincikas.<sup>2</sup> *Decision-making in substance use disorders*. Principal

	supervisor: Karen Ersche. <sup>2</sup>
RA	Predoctoral research assistant (RA), or equivalent level: <ul style="list-style-type: none"> <li>• 2022–, Laura Hannah.<sup>3</sup></li> </ul>
PhD	Doctoral students: <ul style="list-style-type: none"> <li>• 2003–2006, PhD (as advisor): Sanne de Wit.<sup>1</sup> <i>Resolution of conflict between goal-directed actions</i>. Supervisor: Anthony Dickinson.<sup>1</sup></li> <li>• 2017–2022, PhD (as advisor): Tsen Vei Lim.<sup>2</sup> <i>Investigating reward reinforcement learning in stimulant drug dependence using a computational approach</i>. Principal supervisor: Karen Ersche.<sup>2</sup></li> <li>• 2017–, PhD (as clinical supervisor): Emma Rocheteau.<sup>2,5</sup> Principal supervisor: Pietro Liò.<sup>5</sup></li> </ul>
Postdoc	Postdoctoral research associates: <ul style="list-style-type: none"> <li>• 2018–2020: Soumya Banerjee.<sup>2</sup></li> <li>• 2019–2021: Shanquan Chen.<sup>2</sup></li> </ul>
Other	Other research staff: <ul style="list-style-type: none"> <li>• 2013–: Jonathan Lewis, research database manager.<sup>3</sup></li> <li>• 2018–: Linda Jones, patient and public involvement lead.<sup>2</sup></li> <li>• 2018–2019: Francesca Spivack, software developer.<sup>2</sup></li> <li>• 2018–2019: Joe Kearney, software developer.<sup>2</sup></li> <li>• 2019–: Martin Burchell, software developer.<sup>2</sup></li> </ul>

<sup>1</sup>Department of Psychology, University of Cambridge. <sup>2</sup>Department of Psychiatry, University of Cambridge. <sup>3</sup>Cambridgeshire and Peterborough NHS Foundation Trust. <sup>4</sup>École Normale Supérieure, Paris. <sup>5</sup>Computer Laboratory, University of Cambridge.

## External invited lectures and talks (accepted); public engagement

2002	<i>Choice, Behavioral Economics and Addiction</i> . Birmingham, Alabama, USA, 15–17 March 2002.
2003	<i>The Neural Basis of Desire and Addiction</i> . British Neuropsychiatry Association Annual Meeting; London, UK, 14 February 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>Adolescent Brain Development: Vulnerabilities and Opportunities</i> . New York Academy of Sciences; New York City, New York, USA, 18–20 September 2003.
2003	<i>Delayed reinforcement: neurochemistry and neuroanatomy</i> . Gatsby Computational Neuroscience Unit, UCL, Queen Square, London, 21 October 2003.
2004	<i>Neuropsychology of Reinforcement Processes in the Rat</i> . Award lecture for the British Psychological Society Annual Conference, London, 15–17 April 2004.
2004	<i>Neural Mechanisms of Decision Making</i> . Symposium within the Autumn School in Cognitive Neuroscience, University of Oxford, 27–30 September 2004.
2008	<i>Managing behavioural problems in dementia</i> . British Geriatric Society, Cambridge, 1 April 2008.
2010	<i>Delayed reinforcement: an update on animal studies</i> . Gatsby Computational Neuroscience Unit, UCL, Queen Square, London, 26 May 2010.
2013	<i>Ghosts in the mind: the nature and causes of psychosis</i> . Bedford School Medical Association, 15 Mar 2003.
2015–	<i>Psychiatry</i> . Sixth form careers talks, Addenbrooke's Hospital.
2017	<i>De-identified clinical records for research and recruitment</i> . NIHR Clinical Research Network Mental Health Specialty Group, 13 Oct 2017.
2018	<i>De-identified clinical records for research and recruitment</i> . University of Sussex, 6 Mar 2018.
2018	<i>Clinical research databases</i> . Thomas Deacon Academy (BTEC course), Peterborough, 30 Nov 2018.
2018	<i>The Cambridge Mental Health Data Pathfinder</i> . Medical Research Council, London, 20 Jul 2018.
2018	<i>Developing clinical informatics for mind and brain health in Cambridge</i> . CRIS 10 <sup>th</sup> Anniversary, King's College London / NIHR Maudsley Biomedical Research Centre, 6 Dec 2018.
2019	<i>The medium matters: tools for mental health data capture and clinical research</i> . MQ Data Science, Edinburgh, 9 Sep 2019.
2020	<i>The early impact of COVID-19 on mental health and community physical health services and their patients' mortality in Cambridgeshire and Peterborough, UK</i> . MQ Data Science, online/Univ. of Edinburgh, 8 Sep 2020.
2020	<i>Public opinion on sharing data from UK health services for clinical and research purposes without explicit consent</i> . MQ Data Science, online/Univ. of Edinburgh, 4 Dec 2020.

## Teaching and teaching awards

University of Cambridge	<p>MB BChir, School of Clinical Medicine: <i>Depression</i> (lecture, 2016–). <i>Fatigue</i> (clinicopathological conference, 2017–18, 2020–). <i>Mental Health Act and Ethics</i> (2022). “Excellent Teaching Award”, Cambridge University Clinical Students’ Society (2015, 2018).</p> <p>NST II (third year) Neuroscience/Psychology: <i>Brain Mechanisms of Memory and Cognition</i> (2002–5).</p> <p>MVST I<sub>B</sub> (second year) Neurobiology &amp; Human Behaviour: <i>Reasoning about uncertainty and learning strategies in medicine</i> (self-directed exercise, 2005–6). <i>Neuroanatomy practicals</i>, psychiatry component (2021).</p> <p>NST I<sub>B</sub> (second year) Psychology: <i>Introduction to Neurobiology</i> (2003–5). <i>Statistics practical series</i> (2003–5). <i>Emotion and Motivation</i> (2002–4).</p> <p>Department of Psychiatry: <i>Computational psychiatry workshop</i> (2018). <i>MPhil Thesis Writing Workshop</i> (2019–).</p> <p>Department of Experimental Psychology: <i>Guide to ANOVA</i> (2003–4). <i>Graduate programming classes</i> (2003–4). Large-group (30–200) and small-group (1–6) teaching in neuroscience and psychology at second- and third-year undergraduate level (2002–5). 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).</p> <p>Supervisor in endocrinology, reproductive biology, neurophysiology/neurobiology/neuroscience, and psychology (1996–2001). St John’s College, Downing College, New Hall, and Clare College.</p>
NHS	<p>MRCPsych course, Fulbourn Hospital: <i>Emotion and Motivation</i> (2003–4, 2014–15, 2017–20). <i>Motivation</i> (2018). <i>Memory</i> (2004, 2014–15, 2017–20). <i>Physical examination in psychiatry</i> (2010). <i>Schizophrenia: early intervention and assessment</i> (2012). <i>Post-traumatic stress disorder</i> (2013). <i>Psychosis: mechanisms, investigations, rating scales, outcome measures</i> (2015). <i>Psychiatric presentations of organic disease</i> (2015). <i>Learning theory</i> (2017–20).</p> <p>Clinical supervision of junior doctors; ad hoc teaching (medical students, junior doctors, others; 2005–). MHA Approved Mental Health Professional (AMHP) training, CPFT: <i>Mental disorder</i> (2017).</p>
Other	<p><i>Computational modelling and its relevance to psychiatry</i> (2013). Cambridge Neuropsychiatry Day, University of Cambridge and CPFT.</p> <p><i>Masterclass: latest advances in psychopharmacology: Case discussion</i> (2013–14). Cambridge Psychopharmacology Programme, CUP/Neuroscience Education Institute, Cambridge.</p>

## Examining

2003	Assessor (examiner) for the MVST Experimental Psychology I <sub>B</sub> Option, University of Cambridge.
2003–2005	Assessor (examiner) for the Natural Sciences Tripos (NST) Part II Neuroscience, University of Cambridge.
2004–2005	Senior Assessor (examiner) for the Medical & Veterinary Sciences Tripos (MVST) Experimental Psychology I <sub>B</sub> Option, University of Cambridge.
2007–	PhD examiner. <i>Cambridge</i> : Sietse Jonkman, 2009; Joshua Keeler, 2013; Michael Gottschalk, 2015; Suyi Zhang, 2018; Matthew Leming, 2020; Romit Samanta, 2021. <i>King’s College London</i> : Giouliana Kadra-Scalzo, 2017; Aurelie Mascio, 2022. <i>Nottingham</i> : Lourdes Valencia-Torres, 2011. <i>Oxford</i> : Peter Rudebeck, 2007.

## Leadership and administration

CPFT	<p><b>Research: Academic lead clinician</b> (2012–) and <b>principal investigator</b> (2017–), <b>CPFT Research Database</b> (2012–, NHS Research Ethics references 12/EE/0407, 17/EE/0442) and <b>CPFT Clinical Data Linkage Service</b> (2020–, NHS Research Ethics reference 17/EE/0442, Confidentiality Advisory Group reference 20/CAG/0087). Research &amp; Development Leadership Team (2015–). <b>Chair, Research Database Oversight Committee</b> (2016–).</p> <p><b>Clinical informatics: Chair, Clinical Reference Group</b> (2016–2019), subsequently <b>Clinical Design Authority</b> (2019–). Clinical Systems Programme Board (2016–2019), subsequently Digital Transformation Board (2019–). Deputy chair, OneVision Steering Group for electronic health records (2019–2021). Member/clinical lead, Electronic Prescribing and Medicines Administration Steering Group (2022–).</p> <p><b>Other:</b> Medical Education Committee &amp; Rota Group (redesigned rota; 2008–2009). Clinical Effectiveness Group (2021–).</p>
CUH	Junior doctor rota redesigner, medicine (2006). Research Data Governance Committee (2016–2020). Epic speciality lead for Liaison Psychiatry (2021–).
CUH/CPFT	Member, Cambridge Children’s Hospital (CCH) Digital Steering Group (2022–).
NHS	<b>Local:</b> Leadership training course, NHS East of England Multiprofessional Deanery (2013–2014). Cambridge-

shire and Peterborough Sustainability and Transformation Partnership (STP) Digital Enabling Group (2020–).

*National: UK National Institute for Health and Care Excellence (NICE) Specialist Committee Member and Lead Team Member*, Diagnostics Advisory Committee: *6-lead electrocardiogram (ECG) for monitoring cardiac health in people having antipsychotic medication* (2022, Diagnostics Advisory Programme #62, Early Value Assessment).

University of Cambridge *University: MVST Neurobiology and Human Behaviour Committee* (2004–2005). Second MB (Bachelor of Medicine) Exemptions Committee (2004–2005). MVST Part I (preclinical medical/veterinary education) Committee (2004–2005). Gender Equality Steering Group (2016–2017). Open Research Infrastructure Sub-Group (2019).

*Cross-departmental: optimization problems* (including Research Excellence Framework, 2018–; undergraduate project allocation for Physiology, Development & Neuroscience, 2019).

*School of Clinical Medicine: Athena SWAN Steering/Governance Group* (2012–2017). Review Panel on General Practice Academic Clinical Fellowships (2012–2013). Senior Gender Equality Champion (2016–2017).

*Department of Psychiatry: Senior staff* (2016–). Postgraduate Education Committee (2021–). Biomedical Research Centre mental health theme leadership (2021–). Chair, emergency response Silver Command (2022–).

*Department of Experimental Psychology: Senior staff* (2002–2005). Appointment interviewer (2002). **Director of Undergraduate Teaching** (2003). **Chair, Computer Management Group** (2003–2005). **Course organizer**, MVST Ib Experimental Psychology Special Option course (2004–2005). **Course organizer**, Experimental Psychology component of the MVST Ib Neurobiology & Human Behaviour course (2004–2005).

*Behavioural and Clinical Neuroscience Institute: Protocol Review Panel* (2010–2014).

*Selwyn College, Cambridge: Undergraduate admissions interviewer* (2004).

## Editorial work

2016–2021 **Handling Editor**, *Computational Psychiatry* (MIT Press).

## Refereeing

Papers *Addiction; Behavioral Neuroscience; Behavioural Brain Research; Behavioural Pharmacology; Behavioural Processes; Biological Psychiatry; BMC Neuroscience; BMJ Open; Brain; BJPsych; BJPsych Bulletin; BJPsych Open; Drug and Alcohol Dependence; European Journal of Neuroscience; International Journal of Neural Systems; Journal of Comparative Psychology; Journal of Ethnopharmacology; Journal of Experimental Psychology: Animal Behavior Processes; Journal of Neuroscience; Journal of Pediatric Endocrinology and Metabolism; Journal of Psychiatric Research; Neural Networks; Neuropsychopharmacology; Neuroscience & Biobehavioral Reviews; PLoS Computational Biology; Progress in Neuro-Psychopharmacology and Biological Psychiatry; Psychological Medicine; Psychology & Neuroscience; Psychopharmacology; Quarterly Journal of Experimental Psychology; Science*

Books Cambridge University Press

Grants Academy of Medical Sciences; **Agence Nationale de la Recherche** (ANR, French National Research Agency); MQ; **Nederlandse Organisatie voor Wetenschappelijk Onderzoek** (NWO, Dutch Research Council); **Royal Society of New Zealand; UK Biotechnology and Biological Sciences Research Council; UK Medical Research Council; Wellcome Trust**

Fellowships Christ's College, Cambridge; Downing College, Cambridge; **UK Medical Research Council; Wellcome Trust**

## 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*, 2007–2011 (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, Qt, STL, and multithreading environ-



ments), 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. I am the Assignee and Contact for port 3233 (Internet Assigned Numbers Authority).

**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–).

**Office of National Statistics (ONS) Accredited Researcher** (2020–); Accredited Researcher #34 471.

**Music.** Associated Board of the Royal Schools of Music: trumpet, grade 4 (merit, 1985); theory of music, grade 5 (distinction, 1990); piano, grade 8 (distinction, 2022).

## Financial declarations other than income from primary/honorary employers

2002–	Software royalty income from the sales of Whisker and related software by licensee companies: Cambridge Cognition Ltd, 2002–2004; Campden Instruments Ltd, 2004– (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). 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.
2006–	Book royalty income from: Taylor & Francis Group, previously Lawrence Erlbaum Associates (2006–); Cambridge University Press (2011–).
2010–2015	Occasional fees from UK government agencies for Mental Health Act assessments.
2014	Occasional lecture fee from the Neuroscience Education Institute (2014).

## Professional societies and invited positions

1996–	Member, Medical Protection Society.
1999–	Member, European Behavioural Pharmacology Society.
2000–	Member, British Neuroscience Association.
2000–	Member, Society for Neuroscience.
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–); Specialist Register (general psychiatry and liaison psychiatry, 2015–); registration # <a href="#">6029215</a> .
2003–2019	Member, New York Academy of Sciences.
2005–	Member, British Medical Association.
2005–	Associate (2005–2007), Member (2008–2013), and Fellow (2013–), Institute of Biomedical Science (FIBMS).
2006–	Chartered Biologist (2006–2017); Member, Institute of Biology (2006–2009), later Society of Biology (2009–2015), later Royal Society of Biology (2015–2021); Fellow (2021–), Royal Society of Biology (FRSB).
2007–	Chartered Psychologist (CPsychol); Member (2007–2011) and Associate Fellow (2011–), British Psychological Society (AFBPsS).
2007–	Member, British Neuropsychiatry Association.
2007–	Member, Royal College of Physicians of London.
2010–	Member (2010–) and Fellow (2021–), Royal College of Psychiatrists.
2012–	Member, British Association for Psychopharmacology.
2020–	Fellow, Faculty of Clinical Informatics (FCI).