



The RCPsych Gatsby/Wellcome Neuroscience Project

**Professor Wendy Burn
President**

May 2019



Structure of the Project

- **Initially a 2 year project to introduce a modern neuroscience perspective into psychiatrists' clinical work (summer 2016-18)**
- **Generously supported by The Gatsby Foundation and The Wellcome Trust**
- **Based on a USA experience**



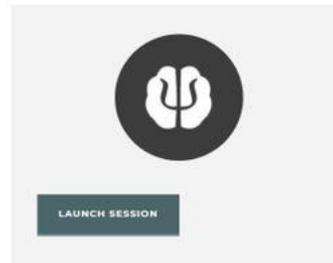
National Neuroscience Curriculum Initiative (USA)

- Making Neuroscience accessible and relevant
- Online, open-access (NIH-funded) learning resource
- www.nncionline.org
- Innovative teaching methods

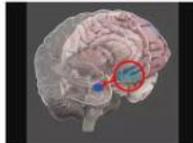


NNCI Website

BASIC NEUROSCIENCE: PLAY-DOH BRAIN



TALKING PATHWAYS TO PATIENTS: BORDERLINE PERSONALITY DISORDER



important
area of feedback
to the amygdala

10:06

COURSE PROCESS

- Part 1
Case Vignette
- Part 2
Watch Video

NNCI Leadership

- **Michael Travis, Pittsburgh**



- **Melissa Arbuckle, Columbia**



- **David Ross, Yale**



RCPsych Gatsby/Wellcome Neuroscience Project



- **Original 2-year project now extended for 3 more years (2018-21)**
- **Focus on adoption and embedding of new Syllabus for MRCPsych**
- **Supported by Gatsby Foundation and Wellcome Trust**



RCPsych Neuroscience Board



- **Oversight of the project**
- **Will monitor and review:**
 - **Adoption and implementation of the new Syllabus for the MRCPsych Examination**
 - **Development of training opportunities, including Brain Camps and a CPD Online module**
 - **Opportunities for interaction between trainees, psychiatrists and neuroscientists**

Neuroscience Board: Members

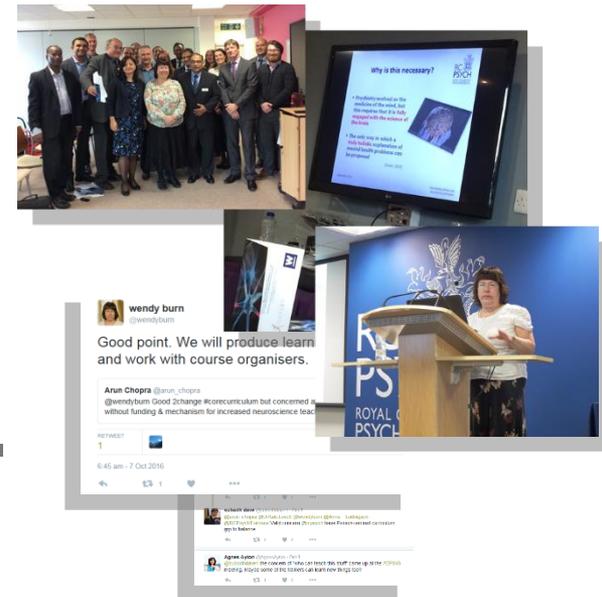


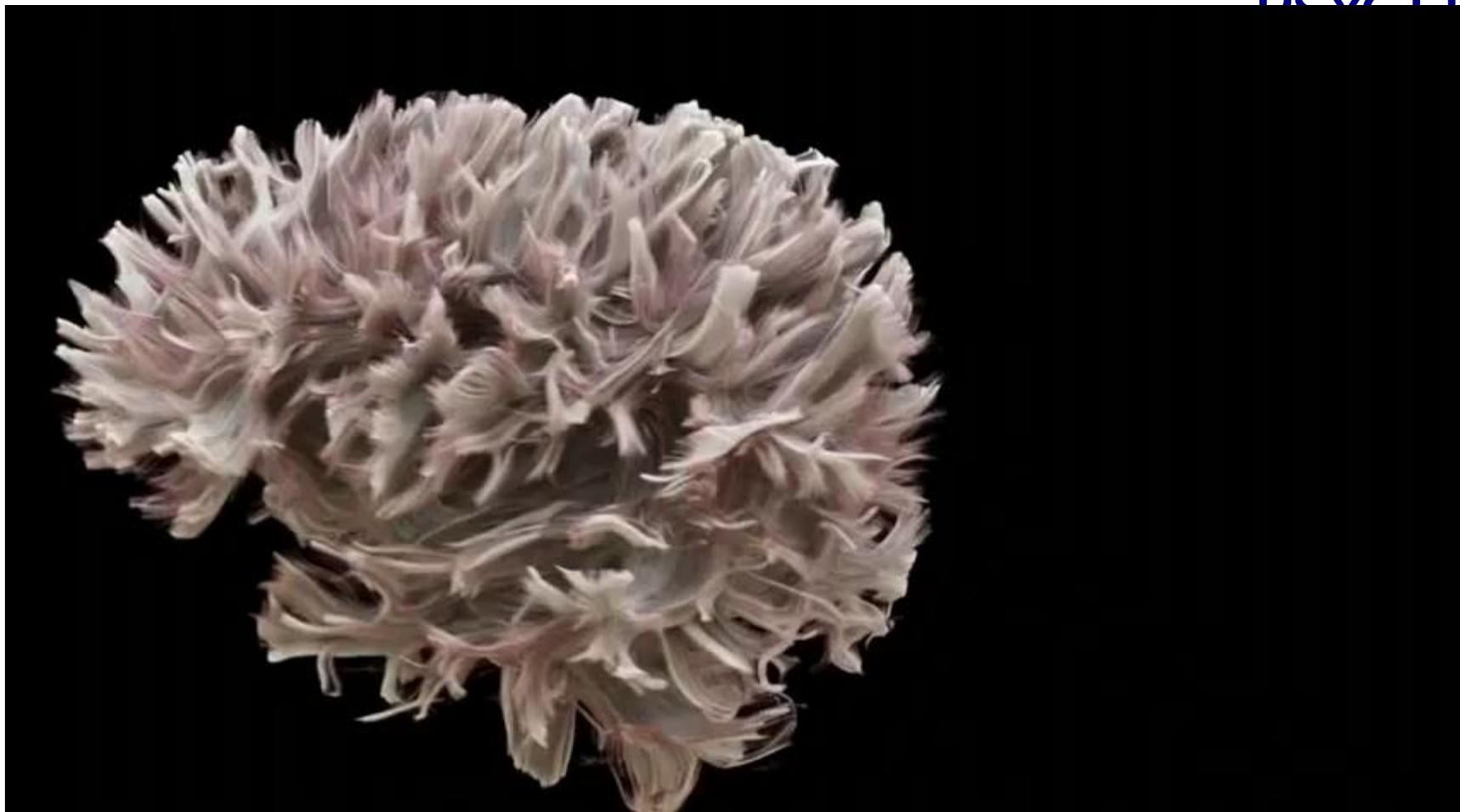
- **Professor Wendy Burn** *(co-Chair), President, RCPsych*
- **Dr Mike Travis** *(co-Chair), UPMC, Pittsburgh*

- **Dr Kate Lovett** *Dean, RCPsych*
- **Professor Ed Bullmore** *University of Cambridge*
- **Professor Sophia Frangou** *Mount Sinai, New York*
- **Professor Eileen Joyce** *UCL, London and Chair, Faculty of Neuropsychiatry, RCPsych*
- **Professor Anne Lingford-Hughes** *Imperial College, London and Chair, Academic Faculty, RCPsych*
- **Professor David Ross** *Yale University*
- **Dr Rick Adams** *UCL, London*
- **Dr Mary-Ellen Lynall** *Academic Clinical Fellow, Cambridge*
- **Dr Sarah Caddick** *Gatsby Charitable Foundation*
- **Dr Andrew Welchman** *The Wellcome Trust*

Continued work: Stakeholder consultation and engagement

- Mentioned in every talk I give as President
- College Faculty and Division conferences/meetings
- Presentations to Trusts, trainees, Foundation Trainees and medical students
- Using neuroscience videos like this next one to engage.....





Achievement: MRCPsych Syllabus updated

3. Neuroscience

The trainee shall demonstrate knowledge of the neuroscience that underpins the practice of clinical psychiatry. This will include: (1) elementary knowledge of the normal structure and functioning of the nervous system as it relates to psychiatry, i.e., the generation of normal mental states and behaviours, and of the dysfunction that leads to mental disorder; (2) ability to relate the symptoms and signs of mental disorder, and the examination of the nervous system, to underlying neural structures and their activity.

3.1 Basic Techniques in neuroscience:

- 3.1.1 Recording from the brain:
 - 3.1.1.1 Single unit recordings
 - 3.1.1.2 EEG (including frequency bands), normal findings, and response techniques. Applications to investigation of cerebral pathology, seizure disorders, sleep and psychiatric disorder effects of drugs on the EEG.
 - 3.1.1.3 Neuroimaging (including structural and functional)
 - 3.1.1.4 Microdialysis
 - 3.1.2 Perturbing brain stimulation, optogenetic and nerve stimulation
 - 3.1.3 Animal models
 - 3.1.4 Computational models

3.2 Cells

- 3.2.1. The types of cells and their anatomical and functional roles in the cortex.
- 3.2.2. Fundamental cellular processes: receptors, ion channels, synaptic transmission, potential, ion flux, allosteric modulation.
- 3.2.3. Modelling single cells and networks.

3.3 Neurotransmitters

- 3.3.1. Transmitter synthesis, storage, release, reuptake and degradation.
- 3.3.2. Knowledge of neurotransmitter receptors and their actions.
- 3.3.3. Knowledge of neurotransmitter systems and their roles in homeostasis and plasticity.
- 3.3.4. Basic pharmacology of noradrenaline, serotonin, dopamine, acetylcholine, excitatory amino acids.

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- 3.3.5. Knowledge of neuropeptides, particularly corticotrophin releasing hormone, cholecystokinin, ghrelin, leptin, GLP-1, enkephalins/endorphins, endocannabinoid system, orexins.
- 3.3.6. Links between neurotransmitter systems and findings from genetic association studies in psychiatry.
- 3.3.7. Effects of opioids and common recreational drugs on neurotransmission, and link to mental health symptoms

3.4. Neuroanatomy

- 3.5.1.10. Emotion and its regulation, including relevance to mood disorders.

Appendix 1 Syllabic curriculum content: Summary of Areas of Core Medical Knowledge Underpinning Specialist Training in Psychiatry

Last updated July 2018

- 3.5.1.4. Aggression
- 3.5.1.5. Pain and chronic pain
- 3.5.1.6. Motor control, including neurobiology of effects
- 3.5.1.7. Learning, including computational models and in pathology (associative learning by unsupervised vs. supervised, reinforcement)
- 3.5.1.8. Habit formation, including neurobiology of compulsions
- 3.5.1.9. Motivation, reward and pleasure, including disorders, psychosis and emotional instability

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- 3.7.2. Types of genetic abnormalities. Conditions associated with chromosomal abnormalities. Principal inherited conditions in psychiatric practice and the genetic contribution to psychiatric disorders. Prenatal identification. Genetic organisation of clinical genetic services, DNA banks.
- 3.7.3. Methods to identify genetic disorders. Techniques in molecular genetics: restriction enzymes, molecular cloning and Southern blotting, restriction fragment length polymorphism.
- 3.7.4. Molecular and genetic heterogeneity. Phenotype/genotype correspondence. Endophenotypes/Biotypes.
- 3.7.5. Epigenetics. The types, causes and effects of epigenetic and the transmission of these changes through generations, drugs, psychotherapy, good and adverse experiences.
- 3.7.6. Gene modification/editing. The emerging techniques of CRISPR-associated (Cas) genes and similar tools for gene editing.

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- 3.9.4. Anxiety Disorders
- 3.9.5. Post Traumatic Stress Disorders
- 3.9.6. Obsessive Compulsive and related Disorders
- 3.9.7. Major Depressive Disorders
- 3.9.8. Bipolar Affective Disorders
- 3.9.9. Psychosis
- 3.9.10. Neurocognitive deficits in psychotic disorders
- 3.9.11. Self-harm and suicidality
- 3.9.12. Medically unexplained symptoms
- 3.9.13. Delirium

3.10. Neurodegeneration

- 3.10.1. Controversies in the pathophysiology of neurodegeneration
- 3.10.2. Alzheimer's Disease
- 3.10.3. Vascular dementia
- 3.10.4. Pick's Disease and Fronto-temporal Dementias
- 3.10.5. Lewy Body diseases including Parkinson's Disease
- 3.10.6. Prion Diseases
- 3.10.7. HIV brain disease

Regional networks: NeuroNets

- Brain researcher—psychiatrist collaboration
- Regional excellence in neuroscience and neuroscience teaching
- Support for trainers

In place:

- Scotland
- Southwest England

Planning:

- Wales
- N. Ireland + NW England



Local course created by **SWNeuroNet**

The Neuroscience in Psychiatry Course 2019

2gether
Making life better



To all Medical Colleagues:

We would like to invite you to NIP, a new and exciting course that has been designed to inspire collaborative learning of neuroscience concepts and shape our understanding of mental illness.

Explore The Role Of Neuroscience In Psychiatry

The course is inspired by the RCPsych Neuroscience Project, which aims to focus psychiatry training on "advances in basic and clinical neuroscience" so that psychiatrists "are better equipped to provide the future".

An Interactive And Innovative Teaching Programme

This is a peer-led course packed with clinically relevant teaching resources, interactive learning upon expertise from leading figures in the field. The programme includes material from the high Neuroscience Curriculum Initiative but is highly tailored to 2gether doctors.

Not Just "Biological Psychiatry"

We'll be thinking about how neuroscience can complement our thinking about all aspects of psychiatry and clinically focussed, with skills to take to the clinic.

Monday 4th March, 2-5pm

Neuroscience Refresher

Exploring the Role of Neuroscience in Psychiatry

Neuroanatomy Refresher



A Quick Guide To Research Techniques In Neuroscience

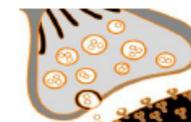
Monday 11th March, 2-5pm

Applications in Clinical Psychiatry

New Insights Into Schizophrenia And Depression

Integrating Neuroscience Into Conversations With Patients

Developing New Treatments



Monday 18th March, 2-5pm

The Bio-Psychosocial Interface

Visualising Psychotherapy Through Neuroimaging



Epigenetics: Trauma and the Brain

A Neuroscience Model Of Personality Disorder

May 2019

Course Facilitators:

Dr George Morris, Dr Lindsey Sinclair, Dr Nik Bhandari,
Dr Emma Phillips, Dr Kim Humby, Dr Clara Martinez, Dr Adrian Yan

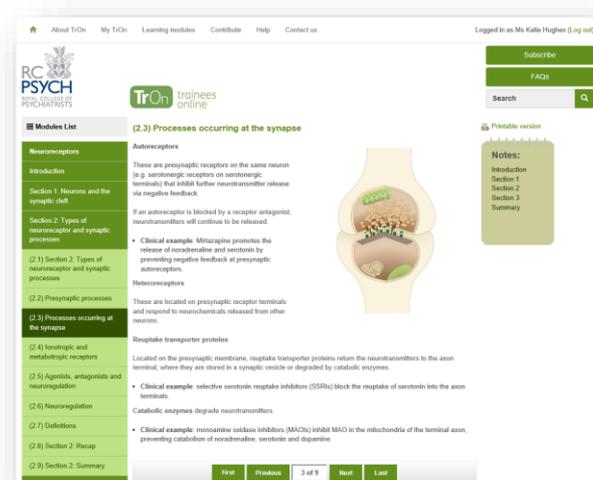
Developing resources: Trainees Online (TrOn)

- College online learning resource
- Free for trainees registered with the college
- Covers Paper A

The screenshot displays the TrOn website interface. At the top, there is a navigation menu with links for Home, About TrOn, My TrOn, Learning modules, Help, and Contact us. The main header features the RCPSYCH logo and the TrOn logo. Below the header, a descriptive text states: "Trainees Online is the online learning resource to support trainee psychiatrists in preparing for MRCPsych exams". The interface is divided into several sections: "My TrOn" with links for About TrOn, Modules in progress, Visit the exam pages, and Visit the trainee pages; "Modules" with a "View all" link and a "Latest module" section for "Physiology of arousal and sleep" by Dr Sonia Sangha, published on 05 Jan 2015, with a duration of 60 minutes; "News" with a "TrOn pOST" section; "Recently published modules" with three featured topics: "The social role of doctors", "Social influence: leadership, power, conformity and obedience", and "Emotion"; and "MRCPsych syllabus" with a link to "Check your learning against the syllabus".

TrOn

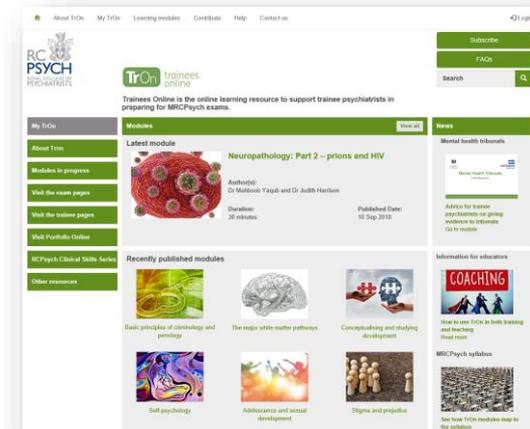
- Produced by higher specialist trainees and junior consultants who have recent knowledge of the examinations themselves



The screenshot displays the TrOn website interface. At the top, there are navigation links: 'About TrOn', 'My TrOn', 'Learning modules', 'Contribute', 'Help', and 'Contact us'. The user is logged in as 'Ms Kelle Hughes (Log out)'. The main content area is divided into a 'Module List' on the left and a detailed view of the selected module '(2.3) Processes occurring at the synapse' on the right. The 'Module List' includes sections for 'Neuroreceptors', 'Introduction', 'Section 1: Neurons and the synaptic cleft', 'Section 2: Types of neuroreceptor and synaptic processes', '(2.1) Section 2: Types of neuroreceptor and synaptic processes', '(2.2) Presynaptic processes', '(2.3) Processes occurring at the synapse', '(2.4) Ionotropic and metabotropic receptors', '(2.5) Agonists, antagonists and neuroregulation', '(2.6) Neuroregulation', '(2.7) Dendritions', '(2.8) Section 2: Recap', and '(2.9) Section 2: Summary'. The detailed view for '(2.3) Processes occurring at the synapse' includes a diagram of a synapse, text describing autoreceptors and heteroreceptors, and a 'Notes' section. The 'Notes' section includes 'Introduction', 'Section 1', 'Section 2', 'Section 3', and 'Summary'. At the bottom of the page, there are navigation buttons: 'First', 'Previous', '1 of 3', 'Next', and 'Last'.

TrOn modules

- Modules cover the whole of the basic sciences syllabus
- Each module includes three pieces of 'Key Reading'
- Extra neuroscience modules will be written



Training events

- Med Ed Conference, Belfast, Sept 2017
- Brain Camp, London, October 2017
- Brain Camp II, Birmingham, June 2018
- Brain Camp III, Manchester, January 2019

Collaboration:

NNCI  NATIONAL
NEUROSCIENCE
CURRICULUM INITIATIVE

BNA

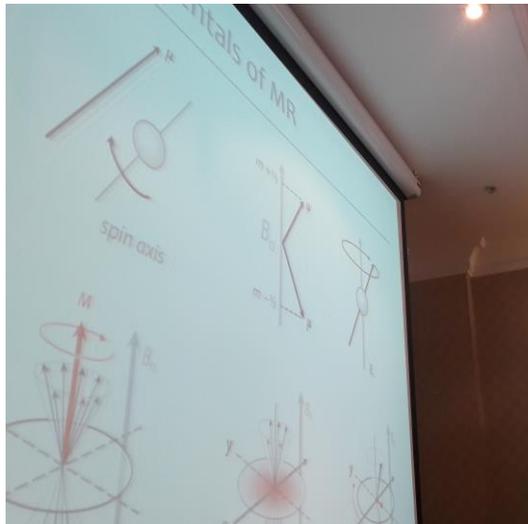
British
Neuroscience
Association

May 2019



Brain Camps

- Over 200 psychiatric educators have taken part to date
- Each event heavily oversubscribed
- Participants from Tewkesbury to Toronto



Brain Camp format

- One-day event
- Refresher on selected cutting-edge, clinically-relevant brain research topics
- Workshops on teaching strategies
- Run by researchers & educationalists
- Training Programme Directors, Clinicians with no background in neuroscience

Programme

09:30-10:00	Registration and refreshments
10:00-10:15	Welcome and Introduction with Dr Kate Lovett, Dean, RCPsych
	Advances in brain research
10:50	<i>Investigating neuropsychological mechanisms in depression using novel rodent models</i> Professor Emma Robinson (Bristol)
11:25	<i>Epigenetics and the challenge of chronic pain</i> Dr Sandrine Gérardon (UCL)
12:00	<i>Experimental models of cortical rhythms: translational biomarkers for drug development for the treatment of schizophrenia</i> Professor Mark Cunningham (Newcastle)
12:45	Lunch and networking
	Teaching workshops
13:35	<i>Storytelling: the role of narrative in neuroscience</i> Dr Derek Tracy (IPP, KCL)
14:25	<i>How to build a brain</i> Dr Gareth Cuttle (RCPsych)



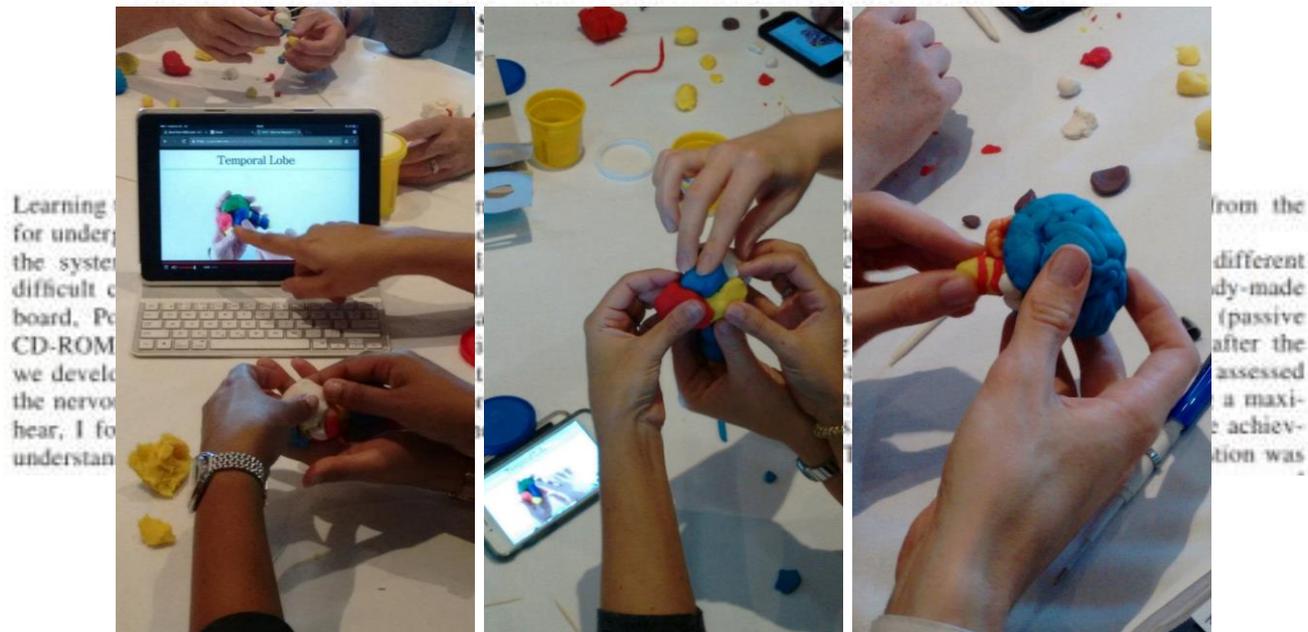
Building Play-Doh brains

- Scientifically proven to educate.....

Adv Physiol Educ 35: 241–243, 2011;
doi:10.1152/advan.00087.2010

Illuminations

Active learning by play dough modeling in the medical profession



Building Play-Doh brains

- Always included
- Enormous fun
- Teaches you how the parts of the brain relate to each other
- Team work



Psychiatric Trainee Neuroscience Champions



- **One from each School**
- **Role:**
 - Cascade news, information and opportunities to trainees; and
 - Feed back to Neuroscience Board on implementation of the new Syllabus for MRCPsych
- **Benefits:**
 - Extra educational opportunities - *Neuroscience Immersion Programme*
One-day conferences with leading researcher speakers and visits to cutting-edge lab facilities

Neuroscience Champions: Launch



Neuroscience Spring Conference 2019

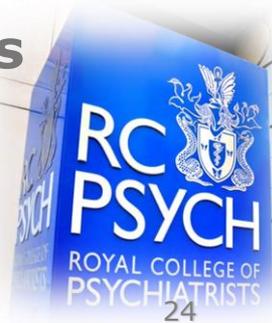


Third Neuroscience Spring Conference

Genetics and epigenetics of
the brain and behaviour

London, March 15, 2019

- **FREE to attend**
- **Travel and accommodation bursaries for Trainees and medical students**





Some highlights from the Programme



8.45-9.30	Arrival and registration
9.30-9.45	Welcome and introduction Professor Wendy Burn President, Royal College of Psychiatrists
9.45-10.30	KEYNOTE 1 The genetics of psychiatric disorders Professor Sir Mike Owen Cardiff University
10.30-11.00	Coffee and refreshments
11.00-11.40	CUTTING EDGE 1 How life events change our behaviour at the molecular level Professor John Quinn Institute of Translational Medicine, University of Liverpool
11.40-12.20	CUTTING EDGE 2 Understanding risk and resilience to psychiatric disorders Professor Sophia Frangou Mount Sinai Hospital, New York
12.20-13.30	Lunch

The genetics of psychiatric disorders
Professor Sir Mike Owen
Cardiff University

How life events change our behaviour at the molecular level
Professor John Quinn
University of Liverpool

13.30-14.15	KEYNOTE 2 Modelling human brain development and connectivity in "mini brain" organoids Dr Madeline Lancaster University of Cambridge
	CUTTING EDGE 3 The impact of life experiences on mental and physical health across generations Dr Ben van Steenwijk Research Institute, University of Zurich
	Coffee and refreshments
	CUTTING EDGE 4 Combining genomic and imaging data in studies of depression Professor Andrew McIntosh University of Edinburgh
	Closing remarks Professor Wendy Burn President, Royal College of Psychiatrists

Modelling human brain development in 'mini brain' organoids
Dr Madeline Lancaster
University of Cambridge

Combining genomic and imaging data in studies of depression
Professor Andrew MacIntosh
University of Edinburgh

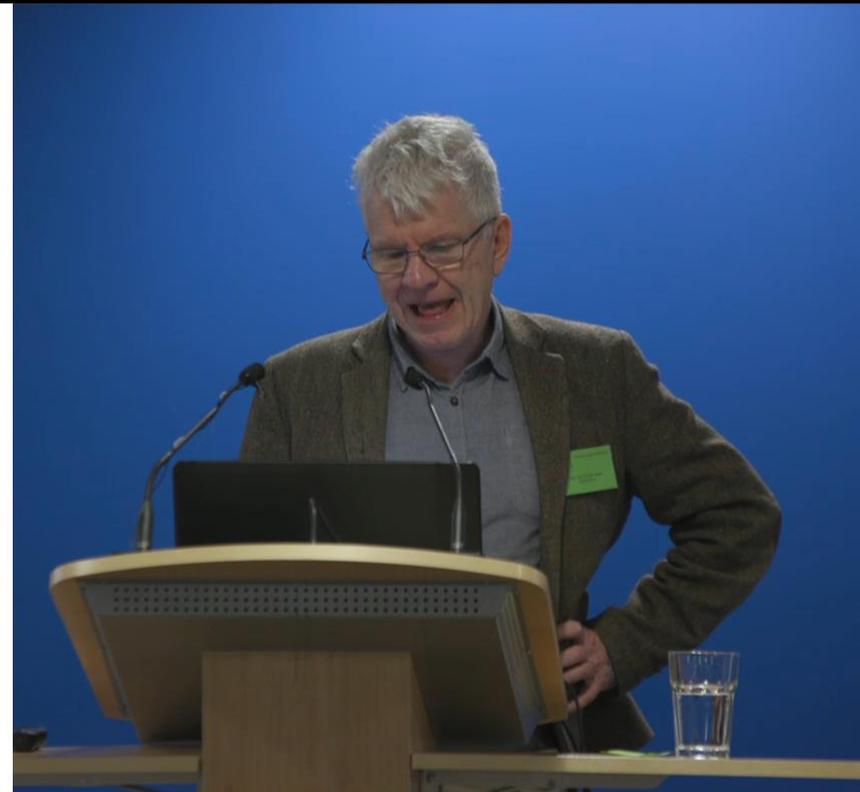
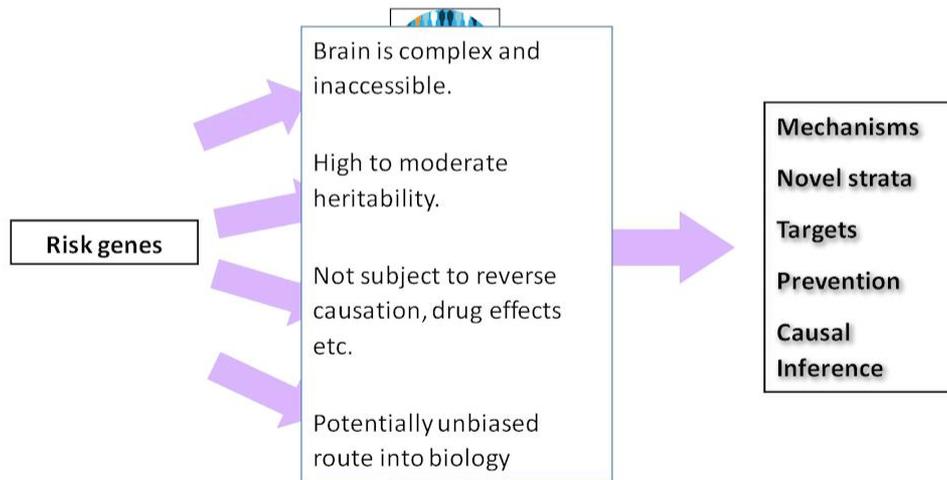


KEYNOTE 1

- **The genetics of psychiatric disorders**
- **Professor Sir Mike Owen
Cardiff University**

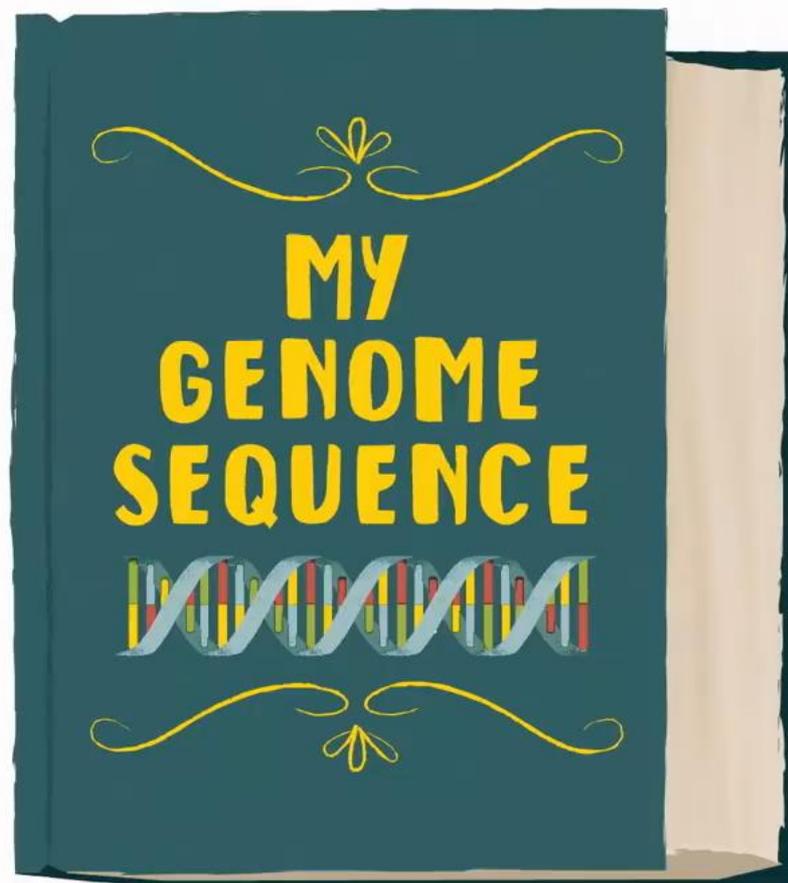


Genomics offers a route to new treatments and strata



Genetics

- **A complex area**
- **A bit of revision for you.....**



Content

- **Review of the recent advances in psychiatric genetics and genomics**
- **Outline likely impact on psychiatric research and practice over the next 10-15 years**



Genomics

- **Offers a new way to understand psychiatric illnesses**
- **Brain is complex and inaccessible**
- **Genes are generally not subject to drug effects**
- **Potentially unbiased route into biology**
- **Identifying genes involved could give greater understanding of the illness**

The Psychiatric Genomics Consortium (PGC)

- Largest global consortium in the history of psychiatry
- Aims to deliver “actionable” findings - genomic results that:
 - reveal the fundamental biology
 - inform clinical practice
 - deliver new therapeutic targets



Schizophrenia Working Group of the Psychiatric Genomics Consortium

- Schizophrenia is a highly heritable disorder
- Genetic risk is conferred by a large number of alleles including common alleles of small effect that might be detected by genome-wide association studies



Multi-stage schizophrenia genome-wide association study

- Schizophrenia Working Group *of the Psychiatric Genomics Consortium*
- 36,989 cases and 113,075 controls
- 108 specific loci found
- 33% of genetic risk from common SNPs (single nucleotide polymorphisms)

ARTICLE

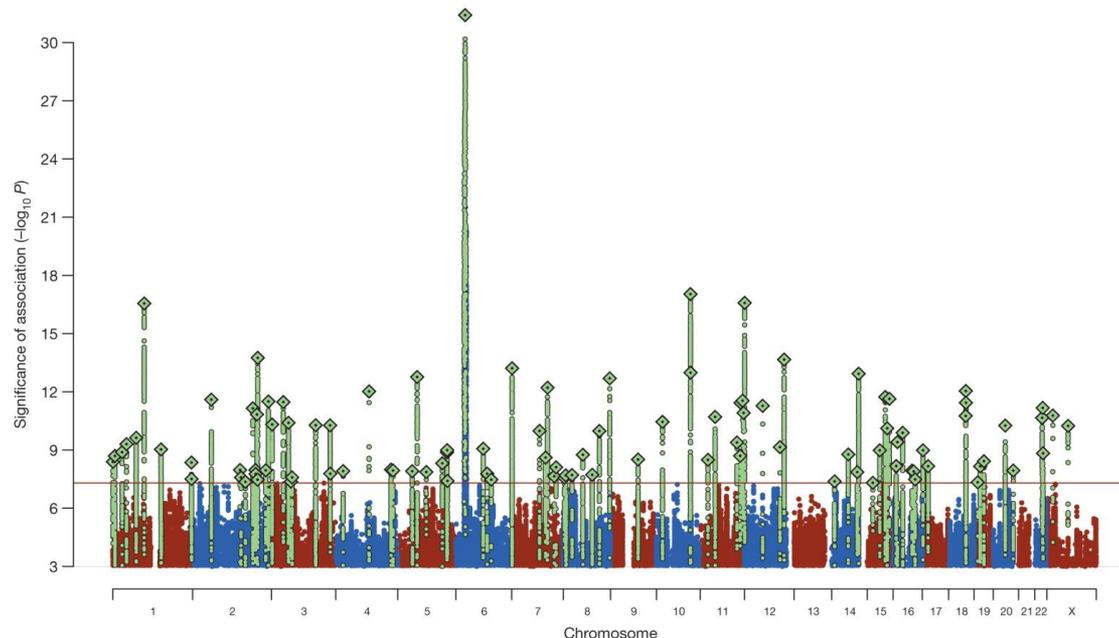
doi:10.1038/nature13595

Biological insights from 108 schizophrenia-associated genetic loci

Schizophrenia Working Group of the Psychiatric Genomics Consortium*

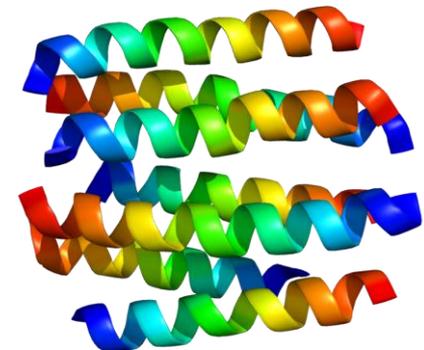
Manhattan plot showing schizophrenia associations

- X axis shows chromosomes, Y shows association significance in schizophrenia



What do the significant genes do?

- Multiple genes involved in glutamatergic neurotransmission
- Also in D2 subtype of the dopamine receptor
- This suggests schizophrenia is fundamentally a disturbance of synaptic transmission

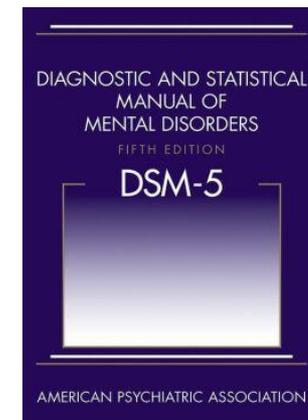
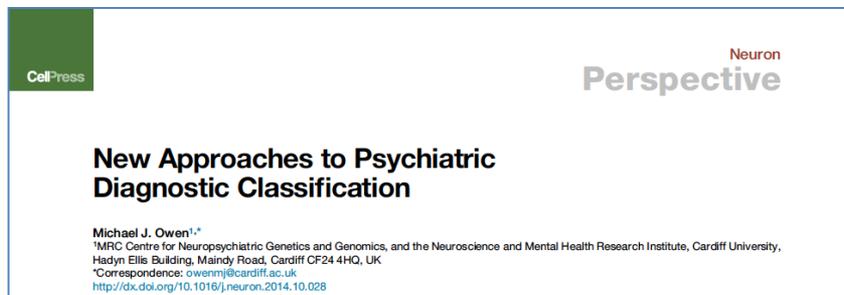


Genome wide association studies on depression

- **Major Depressive Disorder has overlap of genetic risk with schizophrenia**
- **BiPolar type 1 strongly genetically correlated with schizophrenia**
- **BiPolar type 2 is more strongly correlated with Major Depressive Disorder**

What do genetic studies tell us about our classification systems?

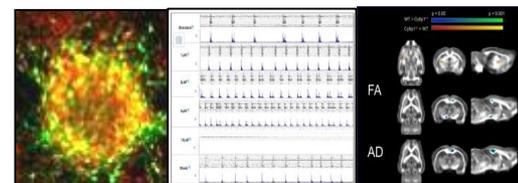
- Classifications based on symptoms likely to be incorrect
- Genomics has the potential to provide a robust, scientific way of classifying mental disorders



Conclusions

Identifying risk genes will lead to:

- Newer and more scientifically valid diagnostic approaches
- Better understanding of disease mechanisms
- Discovery of new drug treatments



Cutting Edge 1

- **'How Life Events Change Our Behaviour At The Molecular Level'**
- **Professor John Quinn
Institute of Translational Medicine,
University of Liverpool**



Mother's touch could change effects of prenatal stress

OPEN

Citation: *Transl Psychiatry* (2015) 5, e560; doi:10.1038/tp.2014.140
www.nature.com/tp

ORIGINAL ARTICLE

Effects of prenatal and postnatal depression, and maternal stroking, at the glucocorticoid receptor gene

C Murgatroyd¹, JP Quinn², HM Sharp³, A Pickles⁴ and J Hill⁵

In animal models, prenatal and postnatal stress is associated with elevated hypothalamic-pituitary axis (HPA) reactivity mediated via altered glucocorticoid receptor (GR) gene expression. Postnatal tactile stimulation is associated with reduced HPA reactivity mediated via increased GR gene expression. In this first study in humans to examine the joint effects of prenatal and postnatal environmental exposures, we report that GR gene (*NR3C1*) 1-F promoter methylation in infants is elevated in the presence of increased maternal postnatal depression following low prenatal depression, and that this effect is reversed by self-reported stroking of the infants by their mothers over the first weeks of life.

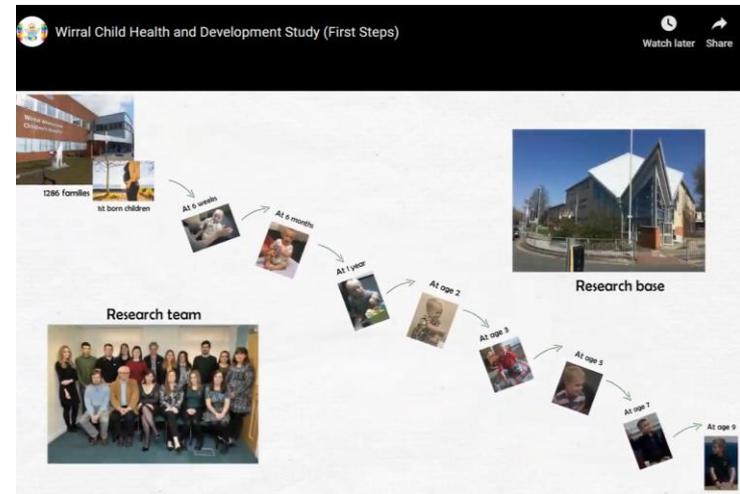


Mothers who stroke their baby's body in the first few weeks after birth may change the effects that stress during pregnancy can have on an infant's early-life development, researchers have found.



Wirral Child Health and Development Study

- UK prospective epidemiological longitudinal study of prenatal and infancy origins of conduct disorders
- Sample now in their teens



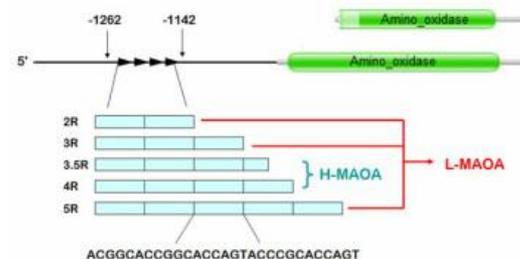
Subsample of 282 mothers and babies

- Life events in pregnancy identified
- Monoamine oxidase A gene (MAOA-LPR) measured in saliva of babies at 5 weeks
- Babies assessed for “negative emotionality”; this is linked to behavioural disorders in later life



Monoamine oxidase A gene (MAOA-LPR)

- Encodes mitochondrial enzymes which catalyse the oxidative deamination of amines eg dopamine, norepinephrine, and serotonin
- Low activity is associated with a variety of psychiatric disorders, including antisocial behaviour



Results

- **Found an interaction between MAOA status and life events during pregnancy ($P = 0.017$)**
- **Those with low MAOA-LPR activity were more likely to be adversely affected by the negative life events**



Conclusions

- Strongly suggests that adverse life events during pregnancy affect babies' behaviour through modification of genes

Genes, Brain and Behavior
Official publication of the International Behavioural and Neural Genetics Society

Genes, Brain and Behavior (2013) doi: 10.1111/gbb.12033

Evidence for interplay between genes and maternal stress *in utero*: monoamine oxidase A polymorphism moderates effects of life events during pregnancy on infant negative emotionality at 5 weeks

J. Hill^{1,*}, G. Breen², J. Quinn³, F. Tibu⁴, H. Sharp⁵ and A. Pickles^{6*}

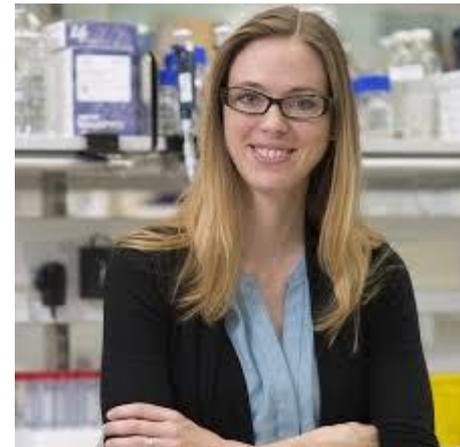
Received 7 January 2013 revised 22 February 2013 accepted for publication 25 February 2013

¹Centre for Developmental Science and Disorders, University of Manchester, Manchester, UK, ²National Institute for Health Research (NIHR) Biomedical Research Centre for Mental Health, South London and Maudsley NHS Foundation Trust and Institute of Psychiatry, King's College London, London, UK

A genotype by environment interaction (G × E) occurs when a person's genotype moderates the effect of environmental experience on physical or mental health outcomes or

Keynote 2

- **Modelling human brain development and connectivity in “mini brain” organoids**
- **Dr Madeline Lancaster
University of Cambridge**



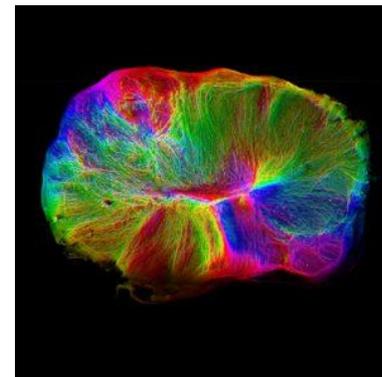
Engagement

- **Have used her research on brain organoids as an example of neuroscience developing**
- **Lab-grown groups of cells that self-organise to resemble an organ**
- **She made this video about her work**
- **Everyone finds it fascinating**



Latest work

- **Neurons in the cerebral organoid seen to be maturing, showed neural activity**
- **Able to see patterns of connectivity between different regions of the mini-brain**



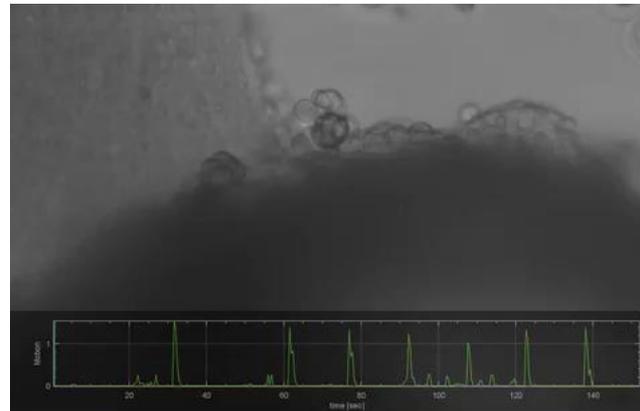
Growing neurons

- Piece of mouse spinal cord and adjacent back muscle was placed near to the organoid
- Neurons from the organoid grew out to connect with the spinal cord
- The mini-brain projecting neurons could stimulate muscle contractions
- First demonstration of a functional output from cerebral organoid tissues in a dish

Evoked Muscle Contractions

- **Demonstration of evoked muscle contractions**
- **The brain organoid is stimulated at regular intervals**
- **Signal sent to the spinal cord, which relays the information to the muscle to make it contract**
- **NEXT SLIDE: see the muscle contracting**

Brain organoid- stimulated muscle contraction



Future implications of this model

- **Could be used to investigate how neurons connect up within the brain and with the spinal cord**
- **Defects in neuronal connectivity may underlie psychiatric illnesses such as schizophrenia, autism, and depression**
- **Improve understanding of conditions in which connectivity is disrupted, such as stroke and dementia**

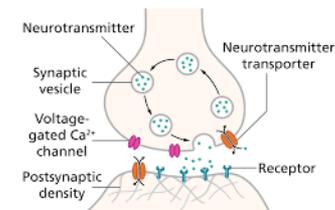
Cutting Edge 4

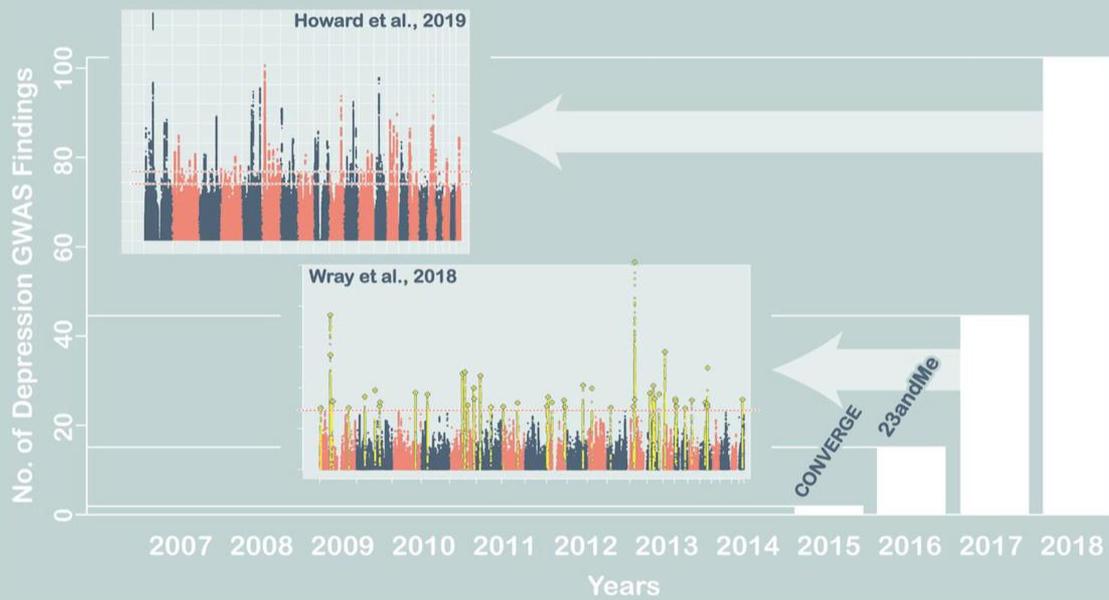
- **'Genomic and imaging studies of depression'**
- **Professor Andrew McIntosh
University of Edinburgh**



Genetics of Depression

- **First studies to identify a genetic contribution to depression were twin studies (identical *versus* non-identical)**
- **These provided an estimate of the total genetic contribution to depression of around 37%**
- **Candidate gene studies inconsistent**





Psychiatric Genomics Consortium

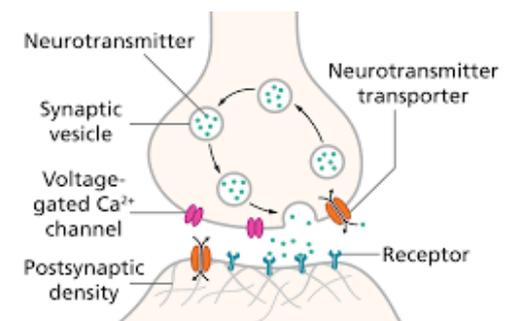


- **Genome-Wide Association Studies (GWAS) looked at depression, 9000 cases & 9000 controls**
- **No variants identified**



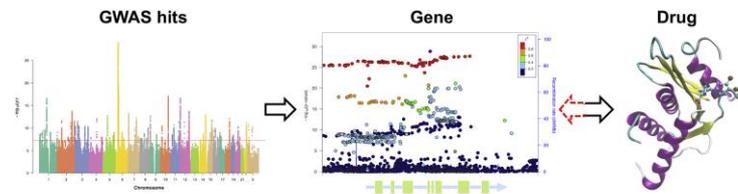
Larger study

- 800,000 people with depression
- 102 independent variants associated with depression
- 269 associated genes
- Genes encoding synaptic proteins are particularly relevant to the aetiology of depression



Genome wide association study

- Schizophrenia associated with variation in the Dopamine D2 receptor, site of action for antipsychotic medications



Trait	Gene with GWAS hits	Known or candidate drug
Type 2 Diabetes	<i>SLC30A8/KCNJ11</i>	ZnT-8 antagonists/Glyburide
Rheumatoid Arthritis	<i>PADI4/IL6R</i>	BB-Cl-amidine/Tocilizumab
Ankylosing Spondylitis(AS)	<i>TNFR1/PTGER4/TYK2</i>	TNF-inhibitors/NSAIDs/fostamatinib
Psoriasis(Ps)	<i>IL23A</i>	Risankizumab
Osteoporosis	<i>RANKL/ESR1</i>	Denosumab/Raloxifene and HRT
Schizophrenia	<i>DRD2</i>	Anti-psychotics
LDL cholesterol	<i>HMGCR</i>	Pravastatin
AS, Ps, Psoriatic Arthritis	<i>IL12B</i>	Ustekinumab

Save the date!



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