WOLFSON RESEARCH EVENT

EXPLORING *Intersections*

2022 PROGRAM BOOKLET

WOLFSON COLLEGE
University of Cambridge

AGENDA

DAY ONE: Friday 29th April 2022

10:45 - 11:15 Registration

11:15 - 11:30 Opening speech

11:30 - 12:30 Oral session 1

12:30 - 13:30 Lunch + networking

13:30 - 14:00 Keynote: Dr Mikołaj Barczentewicz

14:00 - 15:30 Poster session 1 + networking

15:30 - 16:30 Oral session 2

DAY TWO: Saturday 30th April 2022

11:00 – 11:30 Registration

11:30 – 12:30 Oral session 3

12:30 – 13:30 Lunch + networking

13:30 – 14:00 Keynote: Dr Giles Yeo

14:00 – 15:30 Poster session 2 + networking

15:30 – 16:15 Oral session 4

16:15 – 16:45 Keynote: Professor Stephani Hatch

16:45 – 17:15 Awards and closing

18:30 – 19:15 Drinks reception

19:15 – 21:45 Formal Hall

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WELCOME *Message*

We're excited to welcome all of you to our 11th year of the Wolfson Research Event (WRE). This event is a chance to showcase the incredible and diverse research being undertaken by students at Wolfson college. We are excited to be able to return to in person conferences and engage with so many people across the Wolfson community. Spanning two days, we'll hear from a range of current students and distinguished keynote speakers whose work crosses boundaries, explores intersections within and beyond their discipline, and addresses pressing issues in modern society. To close out our event this year, we have the opportunity to network further at a special WRE Formal!

The 2022 Wolfson Research Event is centred around the idea of exploring intersections, a theme that truly characterises the work of our presenters. We invite our attendees to opportunities to explore cross overs , and challenge themselves to think outside the box of their own disciplines.

While the WRE and the world around it have undeniably shifted since its inception, we're incredibly grateful that this event has remained an important fixture of the Wolfson community. In particular, we would like to thank Professor Jane Clarke, Deborah Fitz-Gibbon, Dr Meg Westbury, Laura Jeffrey, all the Fellows who reviewed submissions and our workshop speakers – Dr Godwin Aleku, Dr Stefanie Reichelt, and Dr Debbie Pullinger – for their invaluable support. In addition, this event would not be possible without Wolfson's vibrant community of international scholars, whose work and achievements are at the heart of our college.

On behalf of our committee, we'd like to thank you all for attending this year's event. We hope that you use the WRE as an opportunity to learn, exchange ideas, explore the intersections within and beyond your discipline.

Thank you for joining us this year!
WRE 2022 Organising Committee

RUNNING Order

Day 1: 29th April 2022 (Friday)

Oral presentation session 1 (11.30–12.30)

11.30 Aiden Woodcock - The Value of True Belief
11.45 Ana María Villaveces - Dead Butterflies and Cactus Flowers: The Beauty of Queer Rage and Resistance in Las malas and ¡Tengo miedo, torero!
12.00 Anna Lukina - Making Sense of Evil Law
12.15 Dee Chia - The Performative Dimensions of Positioning Artistic Interventions in Singapore (online)

Keynote Speaker 1 (13:30- 14:00)

Dr Mikołaj Barczentewicz

Poster session 1 (14.00–15.30)

14.00–14.30
Ali Mashhadi - Hydrologic changes associated with the Paleocene Eocene Thermal -Maximum (PETM): Implications for a future warmer world
Aslan Uddin - A comparative study of the views of Muḥammad ʻAbduh and Sir Sayyid Aḥmad Kẖān on issues of modernity
Daniel Keitley - A whole-embryo scale comparison of rabbit and mouse development at single-cell resolution

14.30–15.00
Kavya Kartik - Whose Best Interests? Child Sexuality, Reproductive Autonomy, and the Role of Parental Rights
Lucy Branchflower - Who's Afraid of Queer Gothic?': Representing queer heritage in English historic houses

15.00–15.30
Muireann de h-Ora - Magnetoelectric Coupling in Inorganic/Organic Hybrid Composite Thin Films
Shagun Garg - Tracking Hidden Crisis in National Capital Region, India from Space: Implications of Unsustainable Groundwater Use

Oral presentation session 2 (15.30–16.30)

15.30 Alice Adami - The Stockholm moment: framing international environmental law
15.45 David Boroto - Investigating the infrastructure enabling environment through a systems analysis to strengthen project development
16.00 Lars Schaaf - Understanding Carbon Capture with Machine Learned Potentials
16.15 Rubén Asiaín Mira - From waste to resource: Energy recovery from human urine

Day 2: 30th April 2022 (Saturday)

Oral presentation session 3 (11.30–12.30)

11.30 Ben Woodington - The Dark Side of the Spine: Using Flexible Bioelectronics to Interface with the Spinal Cord
11.45 Lucas De Lima Camillo - Unraveling Aging with Deep Learning
12.00 Sophie Sanford - Antiviral immunity in models of Alzheimer's disease pathology
12.15 Charlotte Clarke - The Impact of Privatization on Children in Care

Keynote Speaker (13:30- 14:00)

Dr Giles Yeo

Poster session 2 (14.00–15.30)

14.00–14.30
Chris McDermott - What are the principal contributory factors in headteacher well-being and negative stress and what measures can be taken by headteachers and others, both proactively and reactively, to improve headteacher well-being?
Daniel Boutros - Understanding Turbulent Fluids
Konstantinos Tsigaridis - The Role of Executive Functions and Mathematical Skills in Physics Problem Solving
Ksenija Laskova - Fostering Self-Regulation in Blended Musical Learning: A Case Study

15.00–15.30
Millie Race - How do we build brains? Investigating mechanical forces in cavitating epithelial tubes
Nathan Magnan - Orbital plane alignment: A new way to study black holes in galactic centre
Vinicius Barros - Decolonising Outer Space

Oral presentation session 4 (15.30–16.15)

15.30 Grace Pyles - The Narwhal's Tusk as the Unicorn's Horn
15.45 Yorick Veenma - How Animals Changed the World during the Cambrian Explosion: Using the Rock Record to Reconstruct 500-Million-Year-Old Environments
16.00 Juliet Harrison-Egan - Spaces for education: interrogating typologies of Cape schools and their role in a democratic South Africa

Keynote Speaker (16:15-16:45)

Professor Stephani Hatch

KEYNOTE *Speakers*

PROF Stephani Hatch

KING'S COLLEGE LONDON

Stephani Hatch is a Professor of Sociology and Epidemiology leading the Health Inequalities Research Group at the Institute of Psychiatry, Psychology & Neuroscience, King's College London. She has over 25 years of experience delivering interdisciplinary health inequalities research with an emphasis on race at the intersection of other social identities. Professor Hatch leads the Tackling Inequalities and Discrimination Experiences in Health Services (TIDES) study, funded by a Wellcome Trust Investigator's Award, that was expanded in 2020 with ESRC funding as part of UKRI's rapid response to COVID-19, in part, to produce more immersive training resources for health and social care staff and managers. Professor Hatch also currently co-leads the Marginalised Communities and Mental Health programme within the ESRC Centre for Society and Mental Health. Professor Hatch integrates collaborative approaches to knowledge production and dissemination, action and outreach in training and research through the Health Inequalities Research Network (HERON), which she founded in 2010. She also leads equality, diversity and inclusion initiatives and has national and international advisory roles in health and volunteer and community sectors.

DR Giles Yeo

UNIVERSITY OF CAMBRIDGE

Giles Yeo got his PhD in molecular genetics from the University of Cambridge in 1998, after which he joined the lab of Prof Sir Stephen O'Rahilly, working on the genetics of severe human obesity. Giles Yeo is now a programme leader at the MRC Metabolic Diseases Unit in Cambridge and his research currently focuses on the influence of genes on feeding behaviour & body-weight. In addition, he is a graduate tutor and fellow of Wolfson College, and Honorary President of the British Dietetic Association. Giles is also a broadcaster and author, presenting science documentaries for the BBC, and hosts a podcast called 'Dr Giles Yeo Chews The Fat'. His first book 'Gene Eating' was published in December 2018, and his second book 'Why Calories Don't Count' came out in June 2021. Giles was appointed an MBE in the Queen's 2020 birthday honours for services to 'Research, Communication and Engagement'.

DR Mikołaj Barczentewicz

UNIVERSITY OF SURREY

Dr Mikołaj Barczentewicz is a Senior Lecturer at the University of Surrey School of Law, as well as the Research Director of the Surrey Law and Technology Hub. He is also a Senior Scholar at the International Center for Law & Economics, Fellow at the Stanford Law School, and a Research Associate at the University of Oxford. Mikołaj is a graduate of the University of Oxford (DPhil, MPhil, MJur) and the University of Warsaw. His research spans technology law and policy, applications of technology in legal practice and research, UK and EU public law, and legal philosophy. Mikołaj approaches those topics combining traditional methods of law and philosophy with computational methods, building on his experience as a professional computer programmer.

ORAL Presentations

Friday 29th April 2022

AIDEN WOODCOCK | The Value of True Belief

Aiden did his undergraduate degree at the University of York in Politics, Philosophy and Economics. He then went on to study at the University of Maryland and the University of Bristol, graduating from the latter with an MA in the History and Philosophy of Science. Currently, Aiden is a doctoral candidate in the Philosophy department at the University of Cambridge under the supervision of Prof. Arif Ahmed. His research lies at the intersection of normative, meta- and formal epistemology, focusing primarily on the nature of epistemic rationality.

Abstract

Why are true beliefs valuable? One reason is practical. Our beliefs are part of what rationalise our actions. I want to drink the clear liquid in my glass if it is martini, but not if it is petrol. Thus, when it actually is petrol that fills my glass, I am better-off believing that it is. It is the true belief that my glass contains petrol that enables me to fulfil my aim of not ingesting poison. True beliefs often have instrumental value in this way. Usually, we are better able to pursue our aims the more accurately informed we are. Is this the end of the story?

In this talk, I entertain the possibility that it might not be. More precisely, I consider the following bold conjecture: Veritism. True beliefs are intrinsically, epistemically valuable.

The first part of the talk will be devoted to expounding veritism and exploring the role some have given it in explaining epistemically rational belief. I then illustrate that, in conjunction with plausible decision principles, veritism has the welcome consequence of entailing seemingly uncontroversial rules of epistemically rational belief. However, for all this, I end the talk on a sceptical note. Whilst I agree with the veritist that we value truth intrinsically, I think this is less significant to explaining rational belief than veritists tend to claim. To establish this, I present a “meta-epistemological” objection which, if successful, demonstrates that truth is only one value amongst many which determine what it is rational to believe.

ANA MARIA VILLAVECES | Dead Butterflies and Cactus Flowers: The Beauty of Queer Rage and Resistance in Las malas and ¡Tengo miedo, torero!

Ana María Villaveces, is a current MPhil student in European, Latin American and Comparative Literatures and Cultures here at Cambridge. She has lived her whole life in Colombia and studied her undergraduate degree in Literature there at the University of Los Andes. She is particularly interested in contemporary Latin American literature as a field of study and, to get even more specific, has read and focuses mostly on horror literature. Her first language is Spanish, but her first favourite books were in English.

Abstract

Language is often a trap of inescapable violence for transgender subjects, a twisted snare that silences critical nuances even as it pushes them to name them. In ¡Tengo miedo, torero! and Las malas –two contemporary Latin American novels– however, transgender subjects refashion language with beauty to name themselves with it and carve out livable spaces for themselves in society. Written by Pedro Lemebel –Chilean queer activist and author– and Camila Sosa Villada –Argentinian transgender writer and retired prostitute– respectively, ¡Tengo miedo, torero! and Las malas tell tales marked by poverty and illness, drug abuse and loneliness in which main characters embedded in societal and grammatical systems that refuse to allow them a voice speak nonetheless. In previous theories on gender, Susan Stryker and Judith Butler present pain as all but inevitable within the violent structure of gendered language, this article argues that this pain is a critical part of transgender narratives: the wound around which they are built. However, it also argues that these particular Latin American novels are built from and within this wound, that they have chosen to highlight the beauty that paradoxically issues from and decorates its rot. The emphasis on beauty creates a form of resistance completely owned by transgendered voices within the novels that bleeds into the language of the novels themselves, turning them into pieces of literary resistance that highlight both the pain and the beauty of the transgender voice.

ANNA LUKINA | Making Sense of Evil Law

Anna is a first-year PhD in Law student, working on a project entitled "Towards a Jurisprudence of Evil Law". Prior to that, she studied at the University of Oxford (BA, BCL) and Harvard Law School (LLM). Her research interests include legal theory, legal history (especially Soviet law), and public law. Anna is also a Professor at the Free University Moscow, a project promoting academic freedom in Russia and CIS, where she taught Anglo-Saxon Legal Theory and Soviet Law. You can find out more about her work at annalukina.me

Abstract

As Green argued, '[w]herever there is law, new moral risks emerge as a matter of necessity'. This is apparent if one studies the legal regimes of Nazi Germany, Soviet Union under Stalin, and slavery in the antebellum United States. Seeking to bring clarity to exploration of this uncomfortable truth about law, in this presentation I aim to introduce, define, and ultimately defend the term 'evil law'. Firstly, I argue that 'evil law' is distinct, not just in degree, but in kind, from merely 'bad' or 'unjust' law and can be defined as law, which, if interpreted according to its best purpose, will enable intolerable harm to the victim themselves. Secondly, I claim that 'evil law' is law despite objections from both its 'external' (Radbruch) and 'internal' (Fuller) immorality. Instead of eschewing legality, evil regimes benefit from it: law serves evil ends by coercing law-subjects into evil deeds, coordinating in pursuit of evil goals, legitimizing evil outcomes, teaching the law-subjects to accept their new social roles as evil-doers and victims of evil, and forming identities conducive to evil causes. Thirdly, I answer Cole's challenge that using the vocabulary of 'evil' is at best reductive and at worst dangerous. On the contrary, referring to 'evil law' does not hinder but instead aids us in asking further questions such as why it is created and sustained. More so, proper use of this term is important as it helps articulate the horror evil law inflicts on those marginalized and corrupted by it.

DEE CHIA | The Performative Dimensions of Positioning Artistic Interventions in Singapore

Dee is a museum administrator and educator. She graduated from the University of Cambridge with a Master of Philosophy, specialising in Technology for Persons Identified with Special Needs. She is currently a Singapore National Arts Council Scholar pursuing a PhD in Sociology, researching into Positioning Theory and Artistic Interventions in Impacting Inclusive Societies under the supervision of Professor Patrick Baert. She is currently also serving as an undergraduate supervisor in the Sociology of Cultural Production, Visual Culture and Positioning Theory.

Abstract

Conducted in the context of Singapore, this ethnographic research examines the tensions faced by artists responding to the rising social phenomenon of participatory community-based "art-for-good" that fulfil social and ethical responsibilities in the past decade in Singapore. It attempts to address the performative dimensions of positioning such "art-for-good", and seeks to generate new knowledge in the sociology of art and contribute to Positioning Theory. Positioning Theory draws attention to how interventions by intellectuals attribute certain features to themselves and to others (Baert, 2012). Hence, the primary objective of this research is to understand how additional social and ethical responsibilities impact the performative aspects of the positioning and self-positioning of artists practising "art-for-good" in Singapore. Interim findings from the fieldwork which involves 10 artists and artist collectives based in Singapore have suggested that the performative dimensions employed by artists who work in the field of participatory community art are intersectional, cross-dimensional, dynamic and malleable, largely due to the multiple identities which artists carry with them over their career trajectories. This study hopes to eventually develop a framework for the study of the performative dimensions in positioning artistic interventions in Singapore.

ALICE ADAMI | The Stockholm moment: framing international environment law

Alice Adami is currently undertaking her second year as a PhD student (part-time) with the Land Economy Department, University of Cambridge (Wolfson College). Alice is a UK qualified solicitor with private practice and in-house corporate/commercial law expertise; her more recent professional experience includes governance and legal roles for WWF International, WWF-Australia and the Aga Khan Development Network. Alice holds a master's degree in international law from The Graduate Institute,Geneva and an LLB (Hons) in Law from UCL.

Abstract

Humanity has entered a critical decade for meeting the world's most pressing environmental challenges. Despite fifty years of multilateral environmental negotiations, agreements and regulation, climate change, deforestation and biodiversity loss have worsened dramatically. At the heart of the matter is the failure to solve the environment-development equation. The origins of this issue are in the 1968-1972 political process culminating in the Stockholm Conference on the Human Environment ("Stockholm moment"): the UN's response to heightened environmental awareness resulting from publications such as Silent Spring and Limits to Growth, the Vietnam war, threat of nuclear weapons and major oil spills. The Stockholm moment has been recognised as foundational for international environmental law. Its legacy still drives global efforts to achieve sustainability: Indira Gandhi's trailbrazing opening speech at the Conference is clearly mirrored in SDG1 "no poverty". But the impact of the Stockholm moment on the conceptual underpinnings of modern environmental protection ("Stockholm mindset") has not been understood. My thesis aims to provide an intellectual discussion that uses law as data to unveil the full paradigm of this mindset and its implications, beyond the anthropocentric vs ecocentric dichotomy. Employing the historical institutionalist metaphor of "critical junctures" as well as framing analysis and process-tracing (case studies), I investigate what made Stockholm special compared to other subsequent choice-points and how it sustained its influence across global environmentalism; I analyse the operationalisation of the Stockholm mindset through the consolidation of environmental language and normative developments such as human rights approaches, the prevention principle and domestic legislation.

DAVID BOROTO | Investigating the infrastructure enabling environment through a systems analysis to strengthen project development

David Boroto is an MPhil student in the Engineering for Sustainable Development course. Born in South Africa to Congolese parents, he describes himself as a third culture kid Canadian defined by his global outlook. A self-proclaimed infrastructure nerd, David's passions lie at the intersection of infrastructure and global development. Prior to Cambridge, he worked for the United Nations Office for Project Services (UNOPS) as an Infrastructure and Project Management Analyst. Based in Copenhagen, he supported developing country governments in their strategic infrastructure planning and financing. His work at UNOPS inspired the research he is exploring here in Cambridge.

Abstract

Globally the current stock of infrastructure is not enough to meet the increasing demand for infrastructure services. An estimated annual $1.5 trillion of infrastructure investment will be needed to fill this infrastructure gap in developing countries alone (UN, 2015). Existing research focuses on the development of robust infrastructure plans containing concept stage projects that, when developed, will help meet infrastructure demand. However, governments often struggle to progress projects from the concept stage through prefeasibility, feasibility, and financing to the point of implementation, leaving the infrastructure gap unfilled. Quality infrastructure development hinges on the strength of a country's infrastructure enabling environment: the plans, policies, frameworks, institutions, finances, political environment, and macroeconomic conditions, that facilitate infrastructure project development (GI Hub, 2019). The infrastructure enabling environment is a broad and complex system that is not fully understood by governments, practitioners and researchers. Developing country governments are often burdened by weak enabling environments, yet it is not clearly understood how the enabling environment can be strengthened to improve infrastructure development. This research aims to conduct a systems analysis to map the infrastructure enabling environment, identify relationships and causal loops within this system, and identify leverage points to improve project development. A framework will be developed to assess the enabling environment, understand its impacts on the infrastructure development process and identify opportunities in the enabling environment to strengthen this process. Interviews and desk research will be conducted in 2-3 case study countries to compare their enabling environment systems and apply the framework in their contexts.

LARS SCHAAF | Understanding Carbon Capture with Machine Learned Potentials

Lars' main interest lie at the intersection of machine learning and simulating atomic systems. Originally, Lars studied theoretical physics at the University of Birmingham, with a focus on Astrophysics. During his internship at the Max Plank Institute for Nuclear Physics, Lars made his first contact with scientific computing while working on a high energy camera that is set to observe x-rays emitted by cosmic particle accelerators. Changing to the University of Cambridge for his masters, Lars started focusing on condensed matter physics with his thesis on quantum information. Here he discovered his passion for computational modelling at the atomic scale.

Abstract

The combustion of fossil fuels significantly contributes to climate change and ocean acidification. One leading strategy in reducing carbon dioxide emissions is carbon capture at point sources, such as power plants and cement factories. Implementing current methods would result in a 30% cost increase for electricity, rendering these approaches unfeasible. Novel mechanisms for carbon dioxide adsorption in porous materials, however, show promise in minimising this cost. To optimise adsorption properties a thorough understanding of the adsorption process is needed.

To elucidate mechanisms, we often need to complement experimental observations with computational simulations. The most accurate methods require a quantum treatment of the atomic system. For large porous structures, running these accurate simulations is computationally unfeasible. Instead, we train machine learning methods to predict the output of such expensive calculations, which can speed the simulation up by factors of ten thousand. With such quick computational methods, we can now explore and predict the behaviour of porous structures in the presence of carbon dioxide for a much larger range of mechanisms. In our approach we do not use machine learning as a black box that predicts carbon capture properties. Instead, we speed up accurate simulations that are built on physical laws, giving us unparalleled insight into the adsorption mechanism at the atomic scale. We hope that this in-depth understanding will help us find novel materials with better carbon dioxide absorption properties. Join us as we explore this interesting intersection between climate change mitigation, chemistry, and machine learning.

RUBÉN ASIAÍN MIRA | From waste to resource: Energy recovery from human urine

Rubén is doing his PhD in chemical engineering at the University of Cambridge. He is part of REWATERGY, a Marie Curie Industrial Doctorate Programme and he is currently conducting the industrial part of his research at Aqualia, a Spanish water management company. His work focuses on the recovery of valuable nitrogen compounds present in human urine and their valorisation as a source of energy.

Abstract

Nitrogen compounds present in wastewater are pollutants which must be removed to avoid damage to lakes and rivers. But nitrogen is also a valuable fertiliser that consumes fossil energy during its production. Conventional processes to remove nitrogen are energy-intensive, representing more than 50% of the energy consumed during wastewater treatment. However, most of the nitrogen pollution in urban wastewater comes from human urine, where nitrogen is found in the form of urea. Furthermore, urea is a hydrogen-rich compound and hence a potential source of energy.

Therefore, alternative systems such as separative toilets and urinals are presented as a promising new avenue for wastewater treatment. They can collect undiluted urine and apply recovery strategies to extract the urea, either for producing energy or fertilisers.

This presentation aims to show the design of a new process to recover energy from human urine. The urea is separated from urine through adsorption on activated carbon and thermally decomposed into hydrogen for energy production in fuel cells. During the hydrogen production activated carbon is regenerated, ready for a new cycle of urea extraction. The process feasibility has been demonstrated at lab-scale using synthetic and real urine.

A full-scale prototype for the adsorption of urea has been constructed using a waterless urinal and it is currently installed in a wastewater treatment plant as a proof of concept. Energy analysis shows that, if this energy recovery system was fully deployed in a city like Cambridge (125,000 inhabitants), electrical production equivalent to 1500 solar panels could be achieved.

WOLFSON RESEARCH EVENT

POSTER *Presentations*

Friday 29th April 2022

ALI MASHHADI | Hydrologic changes associated with the Paleocene Eocene Thermal Maximum (PETM): Implications for a future warmer world

Ali is a Part III (Masters) student at the Department of Earth Sciences, University of Cambridge. He is specialising in Earth Systems and Palaeoclimate records including ice core and marine sedimentary records. His Part III project is to develop a novel palaeo-proxy for climate conditions in the past. In doing so, he has been working at Godwin Laboratory for Palaeoclimate Research under supervision of Professor Hodell for the past few past 6 months. He started studying his degree in Natural Sciences at Wolfson College in 2018 as a mature student.

Abstract

The Palaeocene-Eocene Thermal Maximum (PETM) was one of the most abrupt global warming events in Earth history and has been associated with a large injection of carbon into the ocean-atmosphere system. Evidence suggests that substantial changes also occurred in the hydrologic conditions during the PETM, including increased rainfall amount and intensity that profoundly impacted weathering on land and delivery of fresh water to coastal seas. Improving our understanding of the PETM and how temperature affected the hydrologic cycle will aid in the testing of climate models under warmer climate conditions, thereby improving our ability to forecast future hydrological changes in response to global warming.

The clay fraction of samples from sedimentary cores will be analysed for the δ18O and δD of hydroxyl group using a novel method (DTIA) developed in the Godwin Laboratory. DTIA includes the coupling a thermal gravimeter (TG) and a cavity ringdown laser spectrometer (CRDS). The clay sample is precisely step-heated, allowing the separation of the different types of waters that are released at different temperatures. Simultaneously, the water vapor evolved from the clay sample is analysed for oxygen and hydrogen isotopes by CRDS.

The aim is to measure the isotopic composition of structural water in clay size fractions of sediment collected across the PETM at well-known localities. These sections show a large peak in kaolinite at the PETM suggesting that rainfall and weathering increased at these sites during the PETM. Preliminary results from the North Sea shows a significant variation in hydrogen isotopes of structural water in group clay associated with the PETM interpreted to represent an increase in. This study tries to determine if this signal is reproduced in other PETM sections globally and test the hypothesis of an enhanced hydrologic cycle during the PETM. The results from the East Coast of America show different trend in the isotopic composition of structural water in clay minerals during PETM. This indicates the importance of the clay mineralogy in using hydrogen isotopes of clay as a palaeo-proxy to hydrologic conditions.

ASLAN UDDIN | A comparative study of the views of Muḥammad ʻAbduh and Sir Sayyid Aḥmad Ḵẖān on issues of modernity

Aslan Uddin is studying his MSt in History at the University of Cambridge. He is a qualified Chartered Accountant with a BSc in Accounting and Finance from the University of Warwick. His research focuses on the emphasis and role of reason in Islam, utilising texts in Arabic, English, and Urdu. This research is inspired by the classical discussions of Muslim philosophers, like al-Ghazālī, on the congruence between reason and revelation, and the attempts to form a systematic, rational basis of discussion with interlocutors. Aslan enjoys reading a range of subjects in order to understand the world better and holistically.

Abstract

Islamic intellectuals in the late nineteenth century faced an influx of ideas from Europe through means like colonisation and trade, thus influencing Islamic modernism. My research will comparatively study how the Egyptian Mufti Muḥammad ʻAbduh (1849 – 1905 CE) and Indian reformer Sir Sayyid Aḥmad Ḵẖān (1817 – 1898 CE) reconciled the supernatural aspects of Islam with modernity in terms of reason. I selected these thinkers because they were key contemporary Islamic reformers who lived under British colonisation of their lands and wrote incomplete Qur'anic exegeses with an emphasis on issues of modernity. My research will answer the following primary questions using their exegetical writings: What were their hermeneutics and epistemologies? What were their similarities and differences when interpreting the supernatural aspects of the Qur'ān? How do their hermeneutical methods compare to the Islamic legal hermeneutics of the four Sunni legal schools? Answers to the above questions highlight how the same factors led to different or similar responses (and vice versa), locate their hermeneutics and ideas within Islamic and European intellectual contexts, and identify their differing understandings of modernity and the place of reason in Islam. They also show how different authors utilised Islamic legal hermeneutics within the context of Qur'ānic exegeses, thus highlighting the practical implementation of the theory of Islamic legal hermeneutics. The vast rooms for manoeuvre within hermeneutics allowed different interpretations and innovations but also challenges in consistently applying them. Instead of all Islamic modernists being the same, this study shows the multi-layered and multiple trajectories of Islamic modernists.

DANIEL KEITLEY | A whole-embryo scale comparison of rabbit and mouse development at single-cell resolution

Daniel Keitley is a third-year PhD student on the Wellcome Trust Mathematical Genomics and Medicine PhD programme. Working in the labs of Èlia Benito-Gutiérrez (Department of Zoology) and John Marioni (EBI, CRUK), Daniel's research aims to develop and utilise computational tools for comparing single-cell genomics datasets across species. During his PhD, Daniel has mostly explored this topic through single-cell analysis of rabbit and mouse development, where similarities and differences in gene expression are important to consider in the context of translational medicine and in developing our understanding of human development.

Abstract

Advances in our understanding of human development have far-reaching clinical applications in many areas of reproductive and regenerative medicine. One approach to gain a deep insight into the molecular mechanisms of embryonic development is to universally profile the genes that are being expressed in individual cells of the developing embryo. However, due to the ethical and technical challenges of working with human and non-human primate embryos, these single-cell genomics technologies have primarily been applied to developing mouse embryos as the traditional mammalian model organism. Although the mouse is experimentally very accessible, embryological studies on non-rodent embryos have revealed that many aspects of early mouse development, such as the cup-shaped morphology of the embryo, are inconsistent with other mammals, complicating inferences about human development. In this collaborative project, we constructed a gene expression atlas of rabbit development, an alternative mammalian model, which like human and non-human primate embryos, develops as a flat-disc. We report the molecular profiles of 146,133 individual cells as well as high-resolution histology sections from rabbit embryos spanning gestational days 7, 8, and 9. Using a novel computational pipeline, we compared the gene expression landscapes of the rabbit and mouse at the scale of the entire organism, revealing that the gut and extra-embryonic tissues, involved in interacting with the maternal environment, are highly divergent between the two species. These results showcase many advantages of the rabbit model and set the foundation for a broader cross-species approach to decipher early mammalian development.

KAVYA KARTIK | Whose Best Interests? Child Sexuality, Reproductive Autonomy and the Role of Parental Rights

Kavya Kartik is an LLM student at Cambridge. She holds a physics degree from the university of Texas at Arlington, and studied law at Jindal Global Law School in India. She subsequently worked with the Centre for Justice, Law and Society, eventually as its Assistant Director. Her research interests include queer and feminist theories, critical legal studies, reproductive justice, abolitionist theories, and the intersections of law and marginalisation.

Abstract

Anxieties around childhood/adolescent sexuality inform much of the discourse on ‘children’s rights’, extending to discussions on reproductive rights. Cultural attitudes, variances in upbringing, and domestic laws have imposed and thus afforded different forms of sexual and agentic subjectivities on the ‘child’ around the world. The cultural variance of how these standards become normative thus make the law incapable of coming to a standard; or rather, impose cultural attitudes about what passes for agency. In most countries, the law requires parent consent before a child can obtain an abortion. Similar issues arise when children seek access to contraception or other reproductive health services. One argument in support of parental consent is that the caretakers of a child will act in their ‘best interests’. Relatedly, there is a presumption that children do not have the capacity to fully understand their actions and cannot make decisions related to their bodies. This has led to a protectionist, rather than liberatory, framework which is reflected in both domestic law as well as international human rights instruments such as the UN Convention on Rights of the Child (CRC). This paper offers a comparative analysis the development of laws related to sexuality and reproductive autonomy of children in India and the United Kingdom (specifically England). This paper argues that without a complete reconsideration of parental rights, we are unlikely to do away with the requirement of parental involvement in decision-making regarding sexual and reproductive health (SRH), thus maintaining barriers to accessing SRH information and services.

LUCY BRANCHFLOWER | Who's Afraid of Queer Gothic?': Representing queer heritage in English historic houses

Lucy Branchflower is undertaking a Masters in Building History. Currently researching and promoting the representation of marginalised communities within heritage, her work seeks to connect contemporary queer theory with historic visual culture. Her dissertation explores the gendered architecture of religious solitude in Medieval England. She has previously spoken at the Courtauld Institute of Art's Research Forum on the physical limitations of 'universality' in climate art, and her undergraduate dissertation on artworks produced in solitary confinement received high acclaim and the Huntley-Macdonald Sinclair award from the University of Edinburgh.

Abstract

Historic houses built for and by queer people occupy a complex space within English heritage discourse. In collapsing centuries of time into a single, digestible experience for a visitor, they curate the information they chose to display, often prioritising conservative views on family, social hierarchy, and national image over queer identity. Recent attempts to combat this have overlooked the lived experience of the individual, causing a rift between public and academic approach and opinion.

This research will consider the intersections between public and private in the historic house, focussing on the built space of queer people in eighteenth-century England. Deciphering the period's architectural language of identity, the mechanisms through which these figures used space to signify wealth, status, and sexuality will be considered alongside the sites' current treatment. Today, in light of the queer theoretical movement, these houses are more readily contextualised within academic discourse, but they also cater for those they were never intended to be seen by: the general public.

The relationship between the construction of self and space will be explored through the development of domestic houses into public museums, considering contemporary debates of 'pinkwashing' alongside historic associations of the period's styles with extravagance, perversion, and sexual anxiety. Avoiding a fetishisation of the houses' patrons' sexualities, this research will redress an imbalance that has seen historic houses overlooked in contemporary discussions of representation and identity.

MUIREANN DE H-ORA | Magnetoelectric Coupling in Inorganic/Organic Hybrid Composite Thin Films

In September of 2020, Muireann started her PhD in Driscoll group at the Department of Materials Science and Metallurgy as part of the BeMAGIC Horizon 2020 project, funded by the Marie Sklodowska-Curie Research Fellowship Programme. She obtained my undergraduate joint-honours degree in Mathematics and Physics from University College Cork (2016-2020). Her current area of interest is the development of novel 3D structured flexible multiferroics based on filling mesoporous magnetostrictive oxides with ferroelectric polymers, the assessment of the ferroelectric and magnetoelectric performance, and the modelling of magnetoelectric effects.

Abstract

Magnetoelectric (ME) materials are those whose properties, such as polarization and magnetization, respond to both external magnetic and electric stimuli. Magnetoelectric devices are widely used for electronic memory, drug delivery, and biomedical sensors. In ME composites, the coupling between ferroelectric (FE) and magnetostrictive (MS) materials is controlled by the strain at their interfaces. As these materials do not require a flow of electric current to operate, they boast many applications in technology, healthcare, and memory.

Magnetoelectric thin films can be used for various flexible electronics and biomedical applications but are limited by achieving strong magnetoelectric coupling at room temperature in a simple device. We report on the formation of a hybrid magnetoelectric system based on a new three-step grow-etch-fill process. First, a vertically aligned nanocomposite thin film containing a magnetostrictive CoFe2O4-based material and a sacrificial passive component (MgO) is grown via pulsed laser deposition. Then the MgO is wet chemically etched, to leave a mesoporous structure having 10's nm dimensionality, and then a ferroelectric polymer PVDF-TrFE is electrophoretically deposited into the mesoporous structure. Our study shows a novel approach to magnetoelectric composites. The films have advantages over previous composites of the same composition of having a much higher density of interfaces, seen via scanning electron microscopy (SEM), for more effective strain coupling between the ferroelectric and magnetostrictive phases at directional, high-quality interfaces between the two materials. Also, the ability to tune the magnetic anisotropy in the CoFe2O4 films by adjusting the growth process and achieve strong magnetoelectric coupling is demonstrated.

SHAGUN GARG | Tracking Hidden Crisis in National Capital Region, India from Space: Implications of Unsustainable Groundwater Use

Shagun Garg is an MRes + PhD student at the EPSRC Centre for Doctoral Training in Future Infrastructure and Built Environment (FIBE2 CDT). He would be looking at Remote sensing applications for the monitoring of dynamic behaviors impacting sustainable development. The project is jointly funded by EPSRC and BP. Before joining FIBE2 at University of Cambridge, He worked as Research Assistant at GFZ German Research Centre for Geosciences, Potsdam, Germany. Shagun graduated from the Indian Institute of Technology Bombay, with a master's in technology (MTech) in Civil Engineering with a specialization in Remote Sensing. He was awarded DAAD- KOSPIE scholarship to continue his master's thesis work at Institute of Photogrammetry and Geoinformation (IPI), Leibniz University Hannover, Germany. His research interests include Land Subsidence estimation using satellite Interferometry, Landslide and Flood monitoring, and Multimodal Remote Sensing application for Disaster applications

Abstract

National Capital Region (NCR, Delhi) in India is one of the fastest-growing metropolitan cities which is facing a severe water crisis due to increasing water demand. The over-extraction of groundwater, particularly from its unconsolidated alluvial deposits makes the region prone to subsidence. In this study, we investigated the effects of plummeting groundwater levels on land surface elevations in Delhi NCR using Sentinel-1 satellite images acquired during the years 2014-2020. Our analysis reveals two distinct subsidence features in the study area with rates exceeding 17cm/year in Kapashera - an urban village near IGI airport Delhi, and 7cm/year in Faridabad. The subsidence in these two areas are accelerating and follows the decreasing trend of groundwater depletion. The third region, Dwarka shows a shift from subsidence to uplift during the years which can be attributed to the strict government policies to regulate groundwater use and incentivizing rainwater harvesting. Further analysis using a classified risk map based on hazard risk and vulnerability approach highlights an approximate area of 100 square kilometers to be subjected to the highest risk level of ground movement, demanding urgent attention. The findings of this study are highly relevant for government agencies to formulate new policies against the over-exploitation of groundwater and to facilitate a sustainable and resilient groundwater management system in Delhi NCR.

ORAL Presentations

Saturday 30th April 2022

BEN WOODINGTON | The Dark Side of the Spine: Using Flexible Bioelectronics to Interface with the Spinal Cord

Ben is a final year PhD student, his research focuses on bioelectronic medicine, at the intersection of electrical engineering and clinical neuroscience. Prior to starting his PhD, he worked in medical device research, where, across multiple roles he focused on developing, improving, and launching novel drug delivery devices for respiratory health.

His current research looks at how we can better interface electronics with the spinal cord, with applications in pain management and the treatment of spinal cord injury. He has an interest in translating these technologies and similar ones to clinic to improve and change the standard of care.

Abstract

Implantable electronic devices for diagnosing and treating disease are emerging as a prominent component of modern healthcare. Within this field of therapy, the spinal cord offers an interesting target, as the primary bi-directional information highway between the brain and the rest of the body. However, there remains several technical and clinical barriers within the development of new tools to interface with the central nervous system (CNS). Overcoming these barriers could improve the lives of people suffering from conditions such as Parkinson's, chronic pain, and paralysis as well enabling better neuroscientific research, diagnostics, and prognostics.

In this work, we present thin, flexible, and shape adaptive implants based on electrically conductive polymers which can be used to interface with the CNS. These devices are fabricated using scalable manufacturing techniques to create conformable interfaces up to 100 times thinner than commercially available spinal cord implants. This allows larger coverage than previously possible, whilst minimizing surgical risk during implantation. To validate the surgical implantation of these devices they have been tested within a human cadaver model, with utility-based studies explored in vivo.

After showing our technology can be used as a minimally invasive interface for conventional spinal cord stimulation4, we are now aiming to elucidate the 'dark' side of the spinal cord, where most of the motor information lies. These 360° recording devices have proven to be fascinating tools used to describe the spatial and temporal arrangements of spinal networks and may offer therapeutic benefits in both prognostics and spinal cord injury therapy.

LUCAS DE LIMA CAMILLO | Unraveling Aging with Deep Learning

Lucas Camillo is a biochemist, data scientist, and medical student at the University of Cambridge. He has worked in the basic science of aging with fruit flies for over two years at Brown University, and more recently he has switched to research into computational biology in the longevity space. Lucas has worked for biotech startups and is currently a founding fellow of On Deck Longevity Biotech. In his free time, he enjoys practicing archery and playing videogames.

Abstract

Aging is the highest risk factor for mortality in developed countries. Only recently, however, have researchers been able to modulate healthspan and lifespan in model organisms. Given that aging is a biological process that can be modified in a laboratory, so should it be in humans. One of the main hindrances to human longevity studies is the feasibility of long-term clinical trials; we sought to address this issue by creating one of the most accurate biomarkers of aging with deep learning, dubbed AltumAge. Our model uses a neural network that harnesses DNA methylation, a type of dynamic DNA modification that changes throughout a lifetime, to predict age with a median absolute error of only 2.0 years across all tissues of the human body, roughly 35% lower than the current state of the art. AltumAge also estimates a higher age acceleration for cells with age-related hallmarks such as mitochondrial dysfunction, cellular senescence, and even cancer. In addition to its utility as an aging biomarker, interpretation of AltumAge can give insights into the molecular mechanisms behind aging that may guide discovery of longevity-promoting molecules. For instance, most important age-related genomic features are highly influenced by other DNA methylation sites, expanding the drug-targeting capacity if modulating the former directly is not fruitful. Finally, we also envision a future in which a cheap blood test would be able to tell a person's biological age to guide healthy choices.

SOPHIE SANFORD | Antiviral immunity in models of Alzheimer's disease pathology

Sophie Sanford is a PhD student in Dr William McEwan's group at the UK Dementia Research Institute (UKDRI) at the University of Cambridge. She is studying the relationship between the antiviral immune system and Alzheimer's disease. Before Cambridge, Sophie studied at University College London (UCL) in Immunology and Infection, where she became fascinated by the mechanisms of antiviral immunity. Scientific outreach has been important throughout her time at both institutions. Most recently, Sophie organised and chaired the virtual 'Making It Brain 2021' mini-conference with the UKDRI, to give secondary school students an insight into dementia research and careers.

Abstract

One of the major hallmarks of Alzheimer's disease (AD) is the accumulation of misfolded tau protein in the brain. An increased burden of tau assemblies correlates strongly with a worse cognitive score in AD patients, thus there is increased focus in trying to reduce their load. In AD patients, there is increased production of the antiviral immune signalling molecule, type-I Interferon (IFN). IFN restricts viruses by attracting immune cells into the area of infection, and by boosting the expression of several hundred genes that directly target and remove the virus. However, the role of IFN in the development of AD pathology, specifically tau assemblies, is not well understood. Here we tested whether IFN promotes tau pathology in a mouse model of tau pathology and in cell-based models of tau aggregation. The IFN receptor was genetically depleted in tau pathology mice, which had no response to IFN. Tau pathology was analysed at six months of age. In addition to human cell models, we used a novel model of murine hippocampal brain slice cultures to test the effect of IFN on the aggregation of tau (Miller et al. 2021). Mice lacking the IFN receptor exhibited substantially reduced levels of tau pathology, consistent with IFN signalling driving tau pathology. Supporting these findings, IFNα increased the aggregation of tau in brain slice cultures and in human cells. Understanding the relationship between tau and interferon may provide an innovative route to try and reduce the burden of tau assemblies, thereby slowing cognitive decline in AD.

CHARLOTTE CLARKE | The Impact of Privatization on Children in Care

Charlotte is currently in her second year of her undergraduate degree in history with an interest in 20th century American social history. Having grown up in the English foster care system, Charlotte is deeply passionate about addressing and improving the conditions of children in care and care leavers. Charlotte has also previously worked with children in the foster care system and within the social sector.

Abstract

This research aims to discuss the impact of Independent Fostering Agencies and Private Residential Homes on Children in Care. According to recent reports by the BBC, the number of children in care in England and Wales will rise to 125,000 by 2025. Independent Fostering Agencies are responsible for up to one third of all fostering placements whilst 3 out of 4 children's residential homes are run privately, this is up 40 per cent in the past year. Whilst on one hand, private agencies relieve the pressure placed upon social services under austerity and government budget cuts, the impact on children in care is not considered as much as it should due to the fact that these placements are not regulated to the same standard as local authority placements. This research questions the impact on the outcome of life for children in care using the lens of gender, age, race, and location. This topic is vital due to the rising numbers of children being placed in local authority care and the rising rates of children in care or leaving care turning towards a life of criminality, teen pregnancy or not in employment, education, or training. Furthermore, this research makes the argument that in order to provide better outcomes for children in care, facilities need to provide more provisions such as mental health services, more careers who are passionate and independent life skills training, however independent fostering agencies and private residential homes are not equipped to provide this as it stands.

GRACE PYLES | The Narwhal's Tusk as the Unicorn's Horn

Grace Pyles is a second-year PhD in Archaeology. She received a BA in Anthropology and Art from Whitman College (Walla Walla, WA, USA; 2018) and an MPhil in Biological Anthropology (University of Cambridge; 2019). Grace's current study of the narwhal tusks used as unicorn horns was inspired by a longstanding love of the ocean, an admiration of mythical beasts, and a fascination with how the stories we tell can have a measurable impact on the real world around us. When not chasing unicorns, Grace enjoys sailing, fencing, and sculpting.

Abstract

From the Middle Ages to the mid-17th century, one of the most valuable items a European could own was an alicorn (a unicorn's horn). These horns were used as wards against poison and became potent symbols of power wielded by kings and churches alike. Today, we know the unicorn to be fictional and recognize that "alicorns" traded at this time were, in fact, parts of other animals–rhinoceros horns, fossilized bones, and the tusks of walruses and narwhals, for example. Over time, most of these materials were recognized as fakes–except for the narwhal tusk. For a period before its marine identity became widely known, the narwhal tusk was considered the only "true" alicorn in Europe. I explore why and how the narwhal tusk was able to assume the identity of the unicorn's horn for over five hundred years, and why it was able to retain its status as alicorn for so much longer than other materials were. Though the concept of unicorns existed long before narwhal tusks were available in Europe, this spiralled tusk became inextricable from the unicorn legend in a matter of centuries. I have used illustrated medieval and early modern texts from across Europe to identify how the depicted shape of alicorns changed over time to become more consistently straight and spiralled. I have compared this data to a timeline of narwhal tusks that arrived in Europe through those same centuries to show how the narwhal's tusk both reinforced and changed the unicorn legend.

YORICK VEENMA | How Animals Changed the World during the Cambrian Explosion: Using the Rock Record to Reconstruct 500-Million-Year-Old Environments

Yorick is a PhD-student in sedimentary geology. He is from the Netherlands and obtained his BSc and MSc degrees in Earth Sciences at Utrecht University. Despite being from one of the flattest countries in the world, Yorick became interested in rocks and the stories they can tell us about 'deep time'. Luckily, Yorick also enjoys travelling, as he often has to go on field trips to study the rocks he's interested in. Yorick particularly enjoys working on sedimentary rocks, as these can tell us how landscapes and climates have changed through time.

Abstract

The Cambrian Period (541–485 million years ago) is one of the most pivotal chapters in the history of the Earth: During this period, in a phase known as the Cambrian Explosion, animals first emerged and started interacting with their surroundings. How did these early animals change the environments in which they lived and how did this affect landscapes and climates on a global scale? Using Cambrian rocks, I investigated 1) the effects of animals digging into the seafloor and 2) the effects of the mass-production of animal skeletons, which sink to the seafloor and ultimately get preserved as limestones. The burrows of digging animals introduce oxygen into the seafloor, therefore changing the composition of the seafloor sediment. This effect can be recognized in Wales, where Cambrian rocks that formed at the seafloor are rich in oxidized iron. Such evidence for oxygen in the seafloor, combined with evidence for digging animals, helps us reconstruct how animals changed the chemistry of the seafloor and the overlying oceans. The impact of animal skeletons, which get preserved as limestones, can be studied using a database of Cambrian rock successions around the world. Such a database can show how animals changed the abundance of limestones during the Cambrian Period. As limestones contain carbon, this change may have impacted the global carbon cycle – a central component of the Earth's climate system. The Cambrian Explosion illustrates how animals shape the planet on which we live and how changes to the Earth system can have far-reaching consequences.

JULIET HARRISON- EGAN | Spaces for education: interrogating typologies of Cape schools and their role in a democratic South Africa

Juliet is an architect who cares deeply about creating life-affirming places through thoughtful design and research. She is currently pursuing her PhD at the University of Cambridge, researching spaces of education in a South African context. After receiving a distinction for her Master's in Architecture at the University of Cape Town, Juliet spent 5+ years working in urban- and architectural practice in Cape Town, focusing on sensitive sites such as schools, heritage precincts and social housing. Juliet's strength is in working across scales, integrating intuitive insights with analytical thinking, and mediating between different perspectives to propose creative approaches.

Abstract

Education has transformative capacity, yet most public schools in Cape Town remain in a crisis of quality in which the physical fabric of schools is isolated from its socio-spatial context, undermining teaching, learning and community. Through critical analysis of typologies of schools, this research explores the potential for spaces of education to contribute to more inclusive and spatially integrated cities. These themes are explored in relation to the design and planning of schools at an institutional level; the everyday practices and lives of schools on the ground; and a southern perspective. Pieterse and Simone (2018) characterise the 'Global South' as "cities where the majority holds political, economic, spatial and ecological vulnerability." This is useful in locating the research not in terms of a geographical division; but an understanding of the differing priorities and lived realities of specific contexts, and the need for theories which embrace richness of experience and cultural complexity. It is appropriate that, in response to the prevalent condition of a-contextual school buildings in Cape Town, the research be grounded in a southern perspective, which acknowledges the importance of context in shaping ideas. In South Africa, Modernist city planning was subverted to support Apartheid goals of 'separate development' based on race. Apartheid's legacy remains apparent in the spatially segregated fabric of Cape Town. Unlike most public buildings, schools are distributed evenly throughout the urban fabric. I hypothesize that, as public institutions prevalent throughout the city, increasing the civic role of schools could contribute to addressing spatial inequality.

WOLFSON RESEARCH EVENT

POSTER *Presentations*

Saturday 30th April 2022

CHRIS MCDERMOTT | What are the principal contributory factors in headteacher well-being and negative stress and what measures can be taken by headteachers and others, both proactively and reactively, to improve headteacher well-being?

Chris first graduated from Wolfson in 1976 with a degree in Education. He went on to teach in primary and secondary schools and on courses for adults in the UK, Sweden and Dubai, where he was a School Principal. Chris returned to Wolfson in 2018, embarking on a Master of Studies degree. In 2000 Chris returned to Wolfson for a third time, studying for a Master of Studies in Writing for Performance, which reflects Chris' secondary career as a writer. Chris is currently lecturing to University of Connecticut teachers on the subject of International Perspectives on Developing Cross-Cultural Understanding.

Abstract

'What are the factors in Headteacher Well-being?' The role of headteacher is one of the most stressful. This study gives agency to headteachers, focussing on a eudemonic perspective so that headteachers speak about what can improve their well-being, whilst simultaneously focussing on school improvement. Previous studies, which largely produced quantitative data, concluded that the main issue was workload. This study seeks to 'drill down' to ascertain what aspects of workload are stressful and why. In doing this it recognises that the role of headteachers is key in the functioning of any school. The sequential explanatory design model involves a sequential mixed methods data analysis, with initial surveys forming the context for one-on-one interviews, seeking to explore issues with headteachers in greater, more personal, detail. The main findings involve the invention of the term 'streth' which indicates that one element can be a source of both strength and negative stress. One clear example of this is school staff, who were referred to on 21 occasions as sources of well-being and on 21 occasions as sources of negative stress. Structure and systems were found to be important, but the quality of the relationships between individuals who inhabit these mutually supportive structures is vital. The findings are significant for headteachers and their roles, but there are also wider implications for the education system as a whole. Therefore, if the findings are implemented, they would be of benefit to both headteachers themselves and those they serve i.e. students, parents and society as a whole.

DANIEL BOUTROS | Understanding Turbulent Fluids

Daniel Boutros is a PhD student at the Department of Applied Mathematics and Theoretical Physics. His research interests lie in partial differential equations and fluid mechanics. Partial differential equations describe many dynamical phenomena, such as fluid flows, heat transfer or chemical reactions. He obtained his undergraduate degrees in mathematics and physics at the University of Groningen in the Netherlands, after which he did his master's in mathematics at the University of Cambridge.

Abstract

Both from the physical and the mathematical perspective, the phenomenon of turbulence is poorly understood. From the mathematical standpoint the equations that describe fluid flow are very hard to work with. In particular, one does not know whether the equations can have multiple solutions. In case there are multiple solutions, it is hard to tell which one is "real". Generally speaking, the ultimate goal is to understand how the whole array of possible fluid behaviours can arise from a purely mathematical description. In particular one would like to derive physical theories from mathematical equations.

I will show how combining tools from both physics and mathematics can be used to enhance our understanding of fluid mechanics. In particular, I will discuss the physical effect known as anomalous dissipation. This means that a fluid can lose energy regardless of how low its viscosity is. In particular I will explain how this experimental effect can be understood from a mathematical standpoint.

After mathematical formalisation of this experimental fact, several interesting mathematical structures were uncovered in fluid equations. It was found that there is a "mathematical threshold" for energy conservation in a fluid. Below this threshold, any type of energetic behaviour is possible. Surprisingly, tools from geometry were used to discover this behaviour (which came from the study of curvature of surfaces). These tools were completely new to the world of fluids and the connection is very surprising to say the least.

EDWARD BROWN | Attention-based machine vision models and techniques for solar wind speed forecasting using solar EUV images

Edward's background in physics and machine learning has led him to the strange world of space weather- yes it's a thing. And it certainly is not going to forecast itself. Edward's focus is developing deep learning models to enable forecasting capabilities for space agencies. Specifically, solar images have rich information in them- perfect for algorithmic consumption- that can be used to forecast the conditions for satellites in Earth orbit.

Abstract

Extreme ultraviolet images taken by the Atmospheric Imaging Assembly on board the Solar Dynamics Observatory make it possible to use deep vision techniques to forecast solar wind speed - a difficult, high-impact, and unsolved problem. This study uses a class of algorithm called a Vision Transformer and various techniques to surpass the previous state-of-the-art. The model performs well in the declining phase of the solar cycle, when the solar behaviour is driven by coronal holes.

KONSTANTINOS TSIGARIDIS | The Role of Executive Functions and Mathematical Skills in Physics Problem Solving

Konstantinos holds a BSc in Physics and a MSc in Educational Planning and Teaching both awarded from the University of Athens, and he is currently studying for a PhD in Education. His research focuses on investigating executive functions and their role in science learning. He has been teaching Physics to senior High School students for almost 15 years, preparing them for their National Physics examinations. Through his research, Konstantinos aims to utilize all the experience he has gained from his engagement with students' University entrance examinations to enhance both students' problem-solving skills and their ability to face challenging academic events.

Abstract

Considerable in-depth studies have been carried out in the disciplines of psychology, neuroscience and education concerning the contribution of executive functions to the students' learning process across all school ages. Physics problem solving is one of the key skills that students should develop through physics education and is closely related with executive functions. Previous research has primarily focused on investigating the role of executive functions in students' conceptual change when learning physics yet developing students' physics problem solving skills is one of the primary goals in physics curriculums. Through several studies there have been descriptions concerning the links between executive functions and mathematical skills as well as the role of mathematical skills in physics problem solving. Nevertheless, there is limited research that has examined the contribution of both executive functions and mathematical skills on physics problem solving. To address this gap, this small-scale experiment administered executive functions, physics problem solving and mathematical skills tasks to 20 Greek students (Mage = 16.81 years, SD = 1.87). All the physics and mathematical skills assessments demonstrated a strong positive correlation among them. The figure matching executive function task presented a positive correlation with the physics problem solving and the mathematical skills assessments, when testing for response time and efficiency subsequently. These results offer the opportunity to create a new theoretical approach for physics problem solving that could be the springboard for further investigation, which could result in designing pioneer interventions concerning the teaching practices and better prepare students for challenging academic events.

KSENIJA LASKOVA | Fostering Self-Regulation in Blended Musical Learning: A Case Study

Ksenija has recently completed an MEd in Transforming Practice at Wolfson College (2020-2021) and holds an MA in Music Education and Performance from the Trinity Laban Conservatoire of Music and Dance, BA (Hons) in Music from the Goldsmiths College, the University of London as well as a PGCE in Secondary Music from Homerton College. She has a strong interest in digital education futures, self-regulatory teaching and learning practices and posthuman onto-epistemologies in education. Currently, Ksenija is working as a visiting piano teacher in the state, independent and private sectors in London

Abstract

Existing research within the area of self-regulated learning (SRL) in music highlights the significant potential of SRL to improve the efficiency of the acquisition of musical skills. While SRL has near-universal applicability across different fields of enquiry, the purpose of this study was to explore SRL during blended instrumental learning and practice and investigate whether intervention would increase the students' SRL tendencies. Four secondary-school-aged students who receive one-to-one instrumental lessons volunteered to participate in this study. It was designed as a multiple-case study spanning approximately half of one school term. Data sources included (a) two entrance and exit questionnaires; (b) entrance interviews; (c) entrance and exit video observations, and (d) a focus group exit interview. Approaches to data analysis and discussion of results were rooted in the strong and pertinent philosophical foundation of posthumanism. The SRL intervention designed for this study involved a deliberate use of digital practice journals and personalised tutoring sessions. The author, who is also the piano teacher of the participant volunteers, taught participants about the importance of developing SRL skills and explicitly drew attention to the initial findings of the pre-intervention data related to forethought, performance, and self-reflection phases as well as to attitudes and tendencies towards learning with technology for effective practising during a student's practice session. The intervention had modest effects that varied across participants. Recommendations are made for future research

MILLIE RACE | How do we build brains? Investigating mechanical forces in cavitating epithelial tubes

Millie is a PhD Student in the Physiology, Development and Neuroscience Department, supervised by Dr Clare Buckley and Prof Kristian Franze. Before starting at Wolfson, she completed her undergraduate degree in Biochemistry at the University of Bath which included a 12 month placement at the Francis Crick Institute researching cell and developmental biology. She is interested in how the complexity of organ shape arises from simplicity, specifically how mechanical forces within cells and tissues can coordinate this.

Abstract

In order to build organs during development, cells need to arrange themselves into tissues with complex structures. One such structure, called an epithelial tube, is a hollow tube with epithelial cells facing inwards. This tube is the starting point for many organs, like the brain and spinal cord, so investigating its formation is essential for understanding developmental disorders such as Spina Bifida and hydrocephalus.

To form the brain of mammals, birds, and reptiles; the epithelial tube (called the neural tube) forms through folding a flat sheet into a 3D tube. However, some epithelial tubes like the Zebrafish neural tube and the base of the human spinal cord, form through cavitation of a solid rod to form a hollow tube. Various research has shown that mechanical forces drive the folding of epithelial sheets into tubes- such as constriction in the bottom of the tube to curve either side upwards. But what is the role of mechanical forces in the formation of epithelial tubes through cavitation?

In this study at the intersection of physics and biology, mechanical forces are investigated over the course of neural tube formation in Zebrafish, through investigating the protein non-muscle myosin II which is involved in contractility and generating force in cells. Using immunofluorescence and drug treatments, non-muscle myosin II activation is shown to be important for the opening of the tube, potentially through the function of cilia, but surprisingly it is not important for not the initiation of this process and the cells are not constricting.

NATHAN MAGNAN | Orbital plane alignment: A new way to study black holes in galactic centre

Nathan's academic path revolved around his passion for outer space. He first studied towards a master's in spacecraft engineering, then switched to astrophysics for his PhD. His current research focuses on planet formation, but his past projects include – in no particular order – cosmology, thermodynamics of gravity, semi-conductors, or designing a satellite. He also has a casual interest in the challenges of science communication.

Abstract

Black holes are dim and small, making them tough to observe. Generally, their study relies on expensive gravitational wave detectors. But in the galactic centre, the gravitational pull from a population of small black holes heavily influences the stars' motion. This interaction enables indirect measurements of the black holes' properties from mere telescope observations of the stars. Specifically, the black holes modify the stars' orbital planes in a process called VRR. Our new open-source algorithm computes the outcome of this process. It finds that all massive stars and all black holes spontaneously form a disk. This is an old result, but because our algorithm is so fast, we can perform the first ever parameter exploration.

The thickness of the disk depends on the mass of the galactic centre's objects, with galactic nuclei that contain lighter black holes exhibiting thinner disks. If observers can measure the thickness of the Milky Way's disk, they will be able to relate it to the mass of the black holes. This would help theorists understand how black holes evolve.

With current technology, astronomers already see a hint of a stellar disk. Within ten years, new 30-meter telescopes will provide amazing observations of the galactic centre, which will display an undeniable disk. Additionally, the thinner the VRR disk, the more frequently black holes collide. Within twenty years, the space-based gravitational wave detector LISA will estimate this collision frequency, thereby measuring indirectly the thickness of the VRR disk. Best of all, these two experiments come for free.

VINICIUS ALEXANDRE FORTES DE BARROS | Decolonising Outer Space

Vinicius Alexandre Fortes de Barros is an LLM Candidate focusing on International Law. He is a Chevening FCDO and Cambridge Trust Scholar. Also, he is a Federal Prosecutor in Brazil and worked with international criminal law and human rights. His research focuses on global governance of outer space and protection of vulnerable groups.

Abstract

Recent acts from private international corporations and states demonstrate that outer space is being manipulated as if it was a free for all land. In 2020, NASA revealed the project Nasa Artemis, with aims for lunar colonisation . In the same year, former US President, Donald Trump, encouraged a plan to not only populate the Moon but also to mine it . Additionally, in 2021, the world watched as flights from Virgin Galactic and Blue Origin, both private international corporations, ventured to outer space. As private international corporations initiate a new Space Race, they are doing so without any type of international regulation.

Given this tension, it is necessary a postcolonial approach to analyse international law of outer space. There is a United Nations Treaty on the Use and Exploration of the Moon and Other Celestial Bodies, but spacefaring nations and corporations disregard it.

The postcolonial approach explains the historical origin of certain legal institutes that were supposed to be universal. For example, the Moon is common heritage of mankind, but this is a colonial construction. It entails powerful nations and their corporations to explore the Moon and celestial bodies in detriment of others.

Hence, this research tries to solve this problem and suggests that an international forum should be created specific for settlement projects in celestial bodies. Additionally, suggests that the United Nations Office for Outer Space Affairs needs to regulate projects with such intent.

MEET THE Committee

CAROLINE ARMSTRONG HALL | Programme Officer
Caroline received her Master of Law (LLM) in International Law from Cambridge University in 2021 and was awarded the Hugh Bevan Prize for the most distinguished LLM performance by Wolfson College. Among others, she has previously served as a Legal Consultant to the Permanent Bureau of the Hague Conference on Private International Law and as a Research and Teaching Assistant at the Fletcher School of Law and Diplomacy, Tufts University. She currently works for the institutional legal division of the European Patent Office and enjoys running and dancing in her free time.

CHARLOTTE CLARKE | Communications & Publicity
Charlotte is currently a second-year history undergraduate at Wolfson College. She is also the Publicity Officer for the 2022 WRE. She has previously studied Specialist and Theatrical Makeup and Hair design at University College Birmingham as well as worked within the Social Care Sector with a focus on exploited youth. In her first year at Wolfson, she served as the WCSA President and co- convened the Wolfson College Gender Research Hub. Her research interests are rooted in social histories of Europe and the United States. Charlotte is a keen reader and her favorite book is The Great Gatsby.

ANA GALI MACEDO | Logistics Officer
Ana is a PhD student in pathology and her project focuses on aspects of vaccinia virus infection. Prior to moving to Cambridge, she worked as a research assistant in Portugal, investigating the epigenetic regulation of human pancreatic development using a zebrafish model. Ana did her masters' project in Imperial College, studying the epigenetics of Epstein-Barr virus infection. She initially trained as a microbiologist in the Portuguese Catholic University. She is interested in viral pathogenesis, science communication and science policy. In her free time, she enjoys reading novels, exercising, and discussing topics like freedom of speech, politics, and non-conventional science.

NANCY KARREMAN | Chair
Nancy is a PhD student in Medical Science at Wolfson and this year's WRE Chair. She obtained her BA in Public Policy Analysis – Biology from Pomona College and a MPhil in Health, Medicine & Society from the University of Cambridge. She has also previously worked in tobacco control research at the University of Bath. Nancy's current research interests include public health policy, the commercial determinants of health, and scrutinizing elements of policy speech. In her free time, she enjoys reading and rowing for Wolfson's boat club.

KAVYA KARTIK | Editorial Officer
Kavya Kartik is an LLM student at Cambridge. She holds a physics degree from the university of Texas at Arlington, and studied law at Jindal Global Law School in India. She subsequently worked with the Centre for Justice, Law and Society, eventually as its Assistant Director. Her research interests include queer and feminist theories, critical legal studies, reproductive justice, abolitionist theories, and the intersections of law and marginalisation. In her free time she likes to think and read about Greek mythology.

JIA YI LEE | Programme Officer
Jia Yi is an MPhil in Population Health Sciences student specialising in Epidemiology. She previously studied Nutrition BSc at King's College London. Her research interests are in nutritional epidemiology and dietary public health. She aims to integrate her knowledge in nutrition and epidemiology to study the dietary risk factors of non-communicable diseases to support the development of interventions to improve population health.

ANNA LUKINA | Editorial Officer
Anna is a first-year PhD in Law student, working on a project entitled "Towards a Jurisprudence of Evil Law". Prior to that, she studied at the University of Oxford (BA, BCL) and Harvard Law School (LLM). Her research interests include legal theory, legal history (especially Soviet law), and public law. Anna is also a Professor at the Free University Moscow, a project promoting academic freedom in Russia and CIS, where she taught Anglo-Saxon Legal Theory and Soviet Law. You can find out more about her work at annalukina.me.

VIVIANA ORENA CHÁVEZ | Workshop Officer
Viviana is a physiotherapist and has a MSc degree in Epidemiology. She is currently doing her first year of PhD in Public Health and Primary Care at the University of Cambridge. She is interested in increasing access and participation of patients with Chronic Obstructive Pulmonary Disease (COPD) for Pulmonary Rehabilitation. She belongs to Wolfson College and has been the Workshop Officer for the WRE 2022.

DR. MEG WESTBURY | College Liaison to the WRE Committee
Meg is the Academic Services Librarian (Human and Social Sciences) for the Cambridge University Libraries, and was the Wolfson Lee Librarian from 2013 - 2020. Her research interests include intersections between research infrastructures and students' identities as well as collaborative and peer-supported writing processes.

ALEX LAU | Photographer
Alex is a second year law student from Vancouver, Canada. He has previously completed a degree in Psychology from the University of British Columbia and worked in research for several years. This is his second year being the official photographer for the WRE, and his first for the Wolfson College Boat Club. He is keen on developing his passion for photography into a career, and is open for any opportunity to grow his portfolio, whether it be headshots for Linkedin or social events.

WOLFSON RESEARCH EVENT