The Educated Brain at School: Late Childhood and Adolescence

Part of the 'Educated Brain' seminar series

Thursday 27 October, Buckingham House, Murray Edwards College, University of Cambridge

08:30-09:00 Registration and coffee

09:00-09:20 Introduction, **Dr Michelle Ellefson**, Education, University of Cambridge

09:20-10:00 **Dr Duncan Astle**, MRC Cognition and Brain Sciences Unit

The effect of poverty on cognition, the brain and education

10:00-10:40 **Dr Kirstie Whitaker**, Psychiatry, University of Cambridge

The (still) developing adolescent brain

10:40-11:10 Coffee

11:10-11:50 **Dr Napoleon Katsos**, Linguistics, University of Cambridge

Can people with developmental disorders function successfully as bilinguals?

11:50-12:30 **Professor Liz Pellicano**, Centre for Research in Autism & Education, UCL

The primary-to-secondary school transition for children on the autism spectrum

12:30-13:10 **Professor Usha Goswami**, Centre for Neuroscience in Education, University of Cambridge

Dyslexia and the brain: the role of rhythm

13:10-14:15 Lunch

14:15-17:00 Workshop, including refreshments

Public lecture, Bateman Auditorium, Gonville & Caius College

18:00-19:00 **Professor Charles Nelson**, Harvard University

The effects of early psychosocial deprivation on brain and behavioural development: findings from the Bucharest Early Intervention Project

19:00-19:45 Drinks in Green Room, Gonville & Caius (all welcome)

20.00-22.30 Speakers' dinner, Gonville & Caius

The effect of poverty on cognition, the brain and education

Dr Duncan Astle

Programme Leader, Executive Processes Group, MRC Cognition and Brain Sciences Unit

Following a PhD at the University of Nottingham, Duncan became a Junior Research Fellow at the University of Oxford. He was subsequently a Lecturer at Royal Holloway, University of London, a post which he held alongside a British Academy research fellowship. In 2012 he became a Programme Leader Track Scientist at the MRC Cognition and Brain Sciences Unit in Cambridge, and a Research Associate at St John's College. His research explores the neural and cognitive mechanisms of attention and working memory in the typically and atypically developing brain. The long term aim of this work is to better understand the underlying mechanisms that give rise to variability in attentional control and working memory in childhood, how these might be impaired in special populations and predict educational outcome. More recently his work has explored the extent to which brain mechanisms are altered by interventions targeted at the attention and working memory systems. Find out more about his work here: https://www.mrc-cbu.cam.ac.uk/people/duncan.astle/duncanresearch/.

Abstract: Growing up in a deprived environment can have a profoundly negative effect on a child's development (Lipina et al 2005). Children from deprived backgrounds are more likely to be placed in special education, fail courses, and complete fewer years of schooling (McLoyd 1998). The effect of early deprivation is persistent – growing up in poverty can set a life-long trajectory associated with poor physical and mental well-being (Corak 2006). However, many disadvantaged children are highly resilient. Roughly one third of children growing up in poverty develop into well-adjusted and confident adults, who in many cases exceeded the educational and vocational accomplishments of their wealthier peers (Masten 2001, Werner 1993). We are interested in how cognition, environmental and social influences and brain mechanisms interact to promote this resilience. By better understanding these interactions we hope to provide an evidence-base for future targeted interventions that promote the positive development of all children, regardless of their background. I will provide initial findings from a recently completed cross-sectional study that explores how cognitive, socio-economic and neural factors interact to predict educational outcome. I will then introduce a large multi-modal longitudinal brain imaging project that will run from 2017 to 2021.

The (still) developing adolescent brain

Dr Kirstie Whitaker

Research Associate, Department of Psychiatry, University of Cambridge, and 2016/17 Mozilla Fellow for Science

Dr Kirstie Whitaker is a postdoctoral researcher in the Brain Mapping Unit of the Department of Psychiatry at the University of Cambridge. She is a 2016/17 Mozilla Fellow for Science and a passionate advocate for reproducible neuroimaging research. Dr Whitaker received her PhD in Neuroscience in 2012 from the University of California at Berkeley, funded by a Fulbright scholarship. She is a member of the Neuroscience in Psychiatry Network, a Wellcome Trust funded collaboration between the University of Cambridge and University College London. Her work uses graph theory to study structural brain networks and seeks to explain why so many mental health disorders emerge during adolescence. All her analysis code is openly available at www.GitHub.com/KirstieJane. She is the founder and lead developer of the STEMM Role Models project (www.stemmrolemodels.com) that seeks to ensure conference organisers are able to invite the most exciting and diverse speakers to their event. Her personal website is www.kirstiewhitaker.com and she tweets @kirstie_j.

Abstract: Adolescence is a period of human brain growth and the prolonged changes are in regions of the brain particularly important for complex cognition. I will begin by orienting the audience to some of the common neuroimaging methods used to study the teenage brain, with a focus on what we can - and can not - determine from these techniques. Specifically, magnetic resonance imaging (MRI) allows us to image non-invasively, and at multiple time points from the same participants as they grow up, but the resolution and biological specificity of the images are limited. I will provide an overview of some key developmental studies that elucidate the flexibility of the adolescent brain, and the impact of socioeconomic status on brain structure in adolescence. I will give a more detailed summary of my recent work within the Neuroscience in Psychiatry Network (www.nspn.org.uk) on cortical myelination between the ages of 14 and 24. We found, consistently in two cohorts, that age-related changes in adolescence are concentrated on the more densely connected hubs of the human structural connectome. These hubs are located in associate cortex: the part of the brain that integrates information from multiple regions and generates complex action plans. I will conclude with a demonstration of the power of integrating open data sets such as the gene expression data from the Allen Brain Atlas with non-invasive imaging techniques to improve our understanding of the cellular mechanisms driving adolescent brain development.

References:

1. Mackey, A. P., Finn, A. S., Leonard, J. A., Jacoby-Senghor, D. S., West, M. R., Gabrieli, C. F. O., & Gabrieli, J. D. E. (2015). Neuroanatomical correlates of the income-achievement gap. *Psychological Science*, 26(6), 925–33. http://doi.org/10.1177/0956797615572233
2. Mills, K. L., Goddings, A.-L., Clasen, L. S., Giedd, J. N., & Blakemore, S.-J. (2014). The developmental mismatch in structural brain maturation during adolescence. *Developmental Neuroscience*, *36*(3–4), 147–60. http://doi.org/10.1159/000362328
3. Vértes, P. E., & Bullmore, E. T. (2015). Annual Research Review: Growth connectomics - the organization and reorganization of brain networks during normal and abnormal development. *Journal of Child Psychology and Psychiatry*, *56*(3), 299–320. http://doi.org/10.1111/jcpp.12365
4. Whitaker, K. J.*, Vértes, P. E.*, Romero-Garcia, R., Váša, F., Moutoussis, M., Prabhu, G., … Bullmore, E. T. (2016). Adolescence is associated with genomically patterned consolidation of the hubs of the human brain connectome. *Proceedings of the National Academy of Sciences of the United States of America*, *113*(32), 9105–10. http://doi.org/10.1073/pnas.1601745113

Can people with developmental disorders function successfully as bilinguals?

Dr Napoleon Katsos

Reader in Experimental Pragmatics, Dept. of Theoretical and Applied Linguistics, University of Cambridge

Napoleon Katsos is Reader in Experimental Pragmatics at the Department of Theoretical and Applied Linguistics, University of Cambridge. He is interested in how we learn, process and use the meaning of words and sentences, that is, how we make sense with language. He draws relevant evidence from linguistic theory and experimental psychology, including sentence processing and typical or atypical language acquisition by monolingual or bilingual children. Napoleon is a founding member of the Cambridge Bilingualism Network, for which he received a HEfCE Entrepreneurship Award in 2011. He is committed to raising awareness about the challenges and benefits of raising children bilingually, and to bridging the information gaps that exist between researchers, parents, teachers, clinicians and policy-makers. Napoleon trained as a linguist in Athens, Greece, and then at the University of Cambridge. He worked with Prof Dorothy Bishop at the Dept. of Experimental Psychology, University of Oxford, before returning to Cambridge, first at the Research Centre for English and Applied, and now at the Dept. of Theoretical and Applied Linguistics.

Abstract: Among parents and professionals there is a common, albeit empirically unsupported, belief that bilingual exposure may be detrimental to the language development of children with neurodevelopmental and other related disabilities (Griswold, 2016). In this presentation I will first report the findings from a recent systematic review on the impact of bilingualism on the linguistic and social development of children with neurodevelopmental disabilities (Uljarević et al., 2016). I will then share some findings from research with bilingual children with ASD and their competence with core language and pragmatics (Reetzke et al., 2015). The overall conclusion is that while there are substantial gaps in research, bilingualism does not seem to have an adverse effect on the development of children with neurodevelopmental disabilities, while there are reasons to expect that it might even have a beneficial impact in certain respects.

References:

1. Griswlod, A. (2016). http://www.scientificamerican.com/article/for-children-with-autism-multiple-languages-may-be-a-boon/
2. Reetzke, R, Zou, X., Sheng, L., & Katsos, N. (2015). Communicative Development in Bilingually Exposed Chinese Children With Autism Spectrum Disorders. *Journal of Speech, Language and Hearing Research*, 58(3):813-25.
3. Uljarević, M.. Katsos, N., Hudry, K. and Gibson, J.L. (2016). Multilingualism and neurodevelopmental disorders – an overview of recent research and discussion of clinical implications. Journal of Child Psychology and Psychiatry. 10.1111/jcpp.12596

The primary-to-secondary school transition for children on the autism spectrum

Professor Liz Pellicano

Director, Centre for Research in Autism and Education, UCL Institute of Education, University College London

Liz Pellicano is Professor of Autism Education and Director of the Centre for Research in Autism and Education (CRAE) at UCL Institute of Education. She is an experimental psychologist committed to understanding the distinctive opportunities and challenges faced by autistic children, young people and adults and tracing their impact on everyday life – at home, at school and out-and-about in the community. She is also dedicated both to ensuring that the outcomes of her research are as influential as possible in education policy-making and to enhancing public understanding, including awareness *and* acceptance, of autism. Liz trained as an educational psychologist in Perth, Australia, where she also completed her PhD on the cognitive profile of autistic children, before becoming a Junior Research Fellow in Psychiatry at the University of Oxford and Lecturer in Experimental Psychology at the University of Bristol. She became Director of CRAE in January 2013.

Abstract: Children diagnosed with an autism spectrum condition are known anecdotally to be especially vulnerable during the transition to secondary school. Yet very little is known about the child-, school- and system-level factors that can potentially make changing schools particularly difficult for these children. I will report on a mixed-method study, which examined the factors that influence a successful school transition for autistic children in one UK local education authority. Children were seen twice in the space of 4 months – once during the final term of their mainstream primary school and again during the first term of secondary school. Parents and teachers were also interviewed at both time-points. Overall, the participants in our study reported negative experiences of their transition to secondary school – regardless of which type of secondary provision (mainstream or specialist) they transferred to. Half of the children continued on to mainstream secondary while the other half transitioned to specialist provision. Overall, our participants reported negative experiences of their transition to secondary school – regardless of which type of secondary provision (mainstream or specialist) to which they transferred. None of the child-level factors measured during the pre-transition phase, including verbal ability, autistic symptomatology, sensory responsiveness and anxiety, predicted children's transition success four months later. Rather, transition success appeared to be predominantly related to several school- and system-level factors, including tensions over school choice, delays in placement decisions, lack of primary preparation and communication between schools. Identify-related issues were also a key concern for many children, which appeared to have a particularly negative influence on their adjustment to their new school. These findings have important implications for developing ways to support young autistic people as they are transitioning to secondary school.

References:

1. Humphrey, N., & Lewis, S. (2008). Make me normal: the views and experiences of pupils on the autistic spectrum in mainstream secondary schools. *Autism, 12,* 23-46.
2. Mandy, W., Murin, M., Baykaner, O., Staunton, S., Hellriegel, J., Anderson, S., & Skuse, D. (2016). The transition from primary to secondary school in mainstream education for children with autism spectrum disorder. *Autism, 20,* 5-13.
3. McNerney, C., Hill, V., & Pellicano, E. (2015). Choosing a secondary school placement for students with an autism spectrum condition: A multi-informant study. *International Journal of Inclusive Education, 19,* 1096-1116. DOI: 10.1080/13603116.2015.1037869.

Dyslexia and the brain: the role of rhythm

Professor Usha Goswami

Professor of Cognitive Developmental Neuroscience, University of Cambridge, and Director of the Centre for Neuroscience in Education

Usha Goswami FBA is Professor of Cognitive Developmental Neuroscience at the University of Cambridge and a Fellow of St John's College, Cambridge. She is also Director of the Centre for Neuroscience in Education. After training as a primary school teacher, she decided to pursue research in child psychology, taking a D. Phil. in Psychology at the University of Oxford. Usha has worked on reasoning by analogy, and on reading and developmental dyslexia across languages, most recently studying language encoding by the dyslexic brain with a focus on prosody. Her current research examines developmental relations between phonology and basic auditory processing of amplitude modulation and amplitude rise time, with special reference to the neural oscillatory underpinnings of rhythm. Her goal is to understand the brain basis of dyslexia and speech and language difficulties, and the utility of music- and rhythm-based interventions. She has received a number of career awards, including the British Psychology Society's Spearman Medal and President's Award; the Aspen Brain Forum Senior Investigator Prize in Neuroeducation, New York Academy of Sciences; the Norman Geschwind-Rodin Prize for Dyslexia research, Sweden; and Research Fellowships from the National Academy of Education (USA), the Leverhulme Trust (UK), and the Alexander von Humboldt Foundation (Germany).

Abstract: Recent insights from auditory neuroscience provide a new perspective on how the brain encodes speech. Using these recent insights, I will provide an overview of key factors in the development of language and phonology. I will develop an oscillatory "temporal sampling" neural framework for linking rhythmic auditory processing to phonological development in children. I will show that sensitivity to rhythmic structure is key to developing good phonological skills, and that children with dyslexia are relatively insensitive to rhythm. I will argue that rhythmic sensitivity is related to the neural encoding of energy patterns in speech via neuronal oscillatory entrainment.

References:

1. Goswami, U. (2015). Sensory theories of developmental dyslexia: Three challenges for research. *Nature Reviews Neuroscience*, *16*, 43-54.
2. Power, A.J., Colling, L.C., Mead, N., Barnes, L., & Goswami, U. (2016). Neural encoding of the speech envelope by children with developmental dyslexia. *Brain & Language, 160,* 1-10.
3. Goswami, U. (2013). Dyslexia – in tune but out of time. *Psychologist, 26 (2),* 106-109.

The effects of early psychosocial deprivation on brain and behavioural development: findings from the Bucharest Early Intervention Project

Professor Charles A. Nelson

Professor of Paediatrics and Neuroscience, Harvard Medical School and Professor of Education, Harvard University

Professor Nelson's research interests are concerned with the effects of early experience on brain and behavioural development, particularly the effects of early biological insults and early psychosocial adversity. He studies both typically developing children and children at risk for neuro-developmental disorders (particularly autism), and he employs behavioural, electrophysiological (ERP), and metabolic (fNIRS and MRI) tools in his research. He leads the Nelson Laboratory at Boston Children's Hospital in carrying out research on many aspects of infant and child development.

Abstract: Many aspects of postnatal brain development depend on experience that occurs during relative narrow windows of time (i.e., critical periods) for development to proceed normally. In this talk I will discuss what happens to children whose postnatal experience violates what we have come to expect as a species; specifically, infants who experience profound early neglect. The *Bucharest Early Intervention Project* (BEIP) is a randomized controlled trial of foster care as an intervention for early institutionalization. A total of 136 children who had been abandoned at birth and placed in various institutions in Bucharest, Romania were targeted for study, along with a sample of 72 children who lived with their biological parents in the greater Bucharest community. Following an extensive baseline assessment (average age 22 months), half the institutionalized children were randomly assigned to high quality foster care created by the research team and the other half to care as usual (institutional care). This sample has been carefully studied through the first 16 years of life. Key findings covering a variety of domains (including but not limited to IQ, attachment, and brain development) will serve as the focus of my talk. This work will be situated into the broader framework of the 100 million children around the world who have been abandoned or orphaned, 8 million of whom are being raised in institutional settings.

References:

1. Berens AE, Nelson CA (2015) The science of early adversity: is there a role for large institutions in the care of vulnerable children? *The Lancet, 2015 Jul 25;386(9991):388-98. doi: 10.1016/S0140-6736(14)61131-4. Epub 2015 Jan 29.*
2. Anguish of the Abandoned Child, *Scientific American* (April 2013), Charles A. Nelson III, Nathan A. Fox & Charless H. Zeanah Jr.
3. Sheridan, MA, Fox, NA, Zeanah, CH, McLaughlin, KA & Nelson CA (2012) Variation in neural development as a result of exposure to institutionalization in early childhood *Proc Natl Acad Sci U S A. 2012 Aug 7;109(32):12927-32. doi: 10.1073/pnas.1200041109. Epub 2012 Jul 23. PMID: 22826224*
4. Nelson CA, Zeanah CH, Fox NA, Marshall PJ, Smyke AT, Guthrie D (2007) Cognitive recovery in socially deprived young children: the Bucharest Early Intervention Project, *Science 2007 Dec 21;318(5858):1937-40. PMID: 18096809*