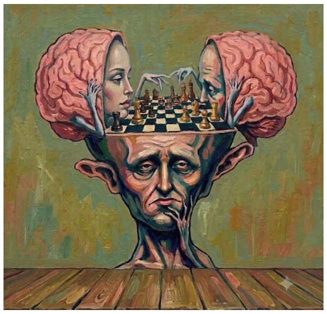

BCN & CAD Symposium

Lateralization of brain, cognition and behaviour
From evolution to clinical relevance

October 30, 2026

Registration

Abstracts

Prof. dr. Chris MacManus

Department of Psychology and Medical Education, University College London, United Kingdom

Cutting handedness at nature's joints, rather than wielding the butcher's axe

Humans show handedness (lateralisation, asymmetry) in many ways, both behavioural and anatomical, 90% preferring to write with their right hand, and 99.99% having their heart on the left side. Multiple and varied asymmetries are also present throughout other animals. In exploring a range of biological handednesses, my title will follow Plato who talked of being,

> "able to cut up each kind according to its species along its natural joints, … [trying] not to splinter any part, as a bad butcher might do" (*Phaedrus*, 265.*e,* Nehemas and Woodruff, 1995).

A butcher can use the power and directed force of an axe or a saw to cut anywhere through a carcass, whereas a surgeon's disarticulation through a joint requires minimal force, sharp scalpels, and a deep knowledge of anatomy. When disarticulation occurs easily that informs about the different materials of which flesh is comprised – bone, tendon, ligament , muscle – and indicates 'natural kinds'. Materials that fall apart easily are indicating their underlying deep structures, reflecting the structure and the fault lines of the natural world, rather than something merely specific to human perceptions and needs.
After looking briefly at the behavioural and statistical 'joints' in right and left hand performance, where bimodality and clustering of performance indicators indicate

separate, distinguishable processes, I will step back and consider the 'biological joints' in the wider evolutionary phylogenetic pictures of differences in asymmetries.
Species, as well as genera, families, orders, classes and phyla, indicate statistical clusterings of organisms, and phylogenetic trees indicate the 'joints' (nodes) where nature can be cut for understanding the evolution of handednesses and asymmetries. Examples will include: anthropoids, Cetacea, flatfish, Foraminifera, marsupials, and teleosts. A key question will be whether asymmetries arise deep in the root of a phylogenetic tree or at the ends of the terminal branches.

Prof. dr. Guy Vingerhoets

Department of Experimental Clinical and Health Psychology, Ghent University, Belgium

Beyond the textbook brain: Individual differences in brain organization and their functional implications

Most people's brain show a characteristic pattern of hemispheric functional segregation, with language and praxis lateralised to the left hemisphere, and spatial attention and face recognition favouring the right hemisphere. This prototypical pattern is believed to result from selective evolutionary adaptation and reflect an optimal division of labour, implicitly assuming that atypical segregation might come at a biological cost. We aimed to investigate individual differences of this population bias and used functional MRI to investigate hemispheric dominance of four cognitive localizers (representing language, praxis, spatial attention, and face perception) in a healthy and representative sample of one hundred right handers and one hundred left handers from the Flemish population. In addition to the MRI-session all participants completed a neuropsychological assessment investigating cognitive performance and IQ-estimation.
In right-handers 71% showed the prototypical hemispheric segregation and 29% showed an atypical pattern (i.e. at least one function lateralized to an atypical hemisphere). In left-handers 42% showed the typical pattern, 8% showed a complete reversal of the typical pattern, and half of the left-handers showed atypical functional segregation. We will compare these results against current putative mechanisms of hemispheric specialization and discuss the implications for these models. Contrary to expectations, no significant group differences were found for cognitive or IQ performance between participants with typical, atypical, or reversed typical functional segregation. Alternative accounts to explain the relation between brain organization and cognition include the (in)consistency of the lateralized network as observed in some neurodevelopmental disorders. Empirical findings in participants with dyslexia will be used as an example. We suggest that decomposing the population bias into at least three different sub-biases and explore the effects of each component on behaviour might help structure research on the complex interaction between individual differences in brain organisation and its functional repercussions. We will also underline the implications of the high prevalence in atypical brain organization for research and clinical protocols.

Prof. dr. Sebastian Ocklenburg

Department of Psychology, Medical School Hamburg (MSH), Germany

Clinical Relevance of Lateralization

Functional and structural brain asymmetries are fundamental principles of brain organization, and a large body of research suggests a higher prevalence of atypical hemispheric asymmetries in various groups of patients with mental and developmental disorders. In this talk, I will give an overview about several recent theoretical developments, empirical studies and meta-analyses that focused on hemispheric asymmetries in clinical groups. In general, atypical asymmetries are more prevalent in patients with mental and developmental disorders compared to healthy controls. However, case-control differences vary substantially with diagnosis. Some diagnoses, like schizophrenia, autism spectrum disorders and dyslexia are associated with a higher prevalence of atypical asymmetries than other diagnoses. Specifically, the data suggest that neurodevelopmental conditions, nonneurodevelopmental conditions with an early age of onset, and conditions that include symptoms related to language were all associated with higher rates of atypical functional asymmetries. These finding suggests that the association between atypical asymmetries and clinical conditions is best understood from a transdiagnostic, developmental, and symptom-focused perspective. Moreover, I will also highlight the relevance of lateralization for disease symptom onset in neurodegenerative diseases and their implications for lateralized treatments, including brain stimulation.

Prof. dr. Elisa Frasnelli

School of Life Sciences, University of Lincoln, United Kingdom

The Asymmetric Advantage: Evolutionary evidence and functional significance of lateralization in non-human animals

Evidence of lateralization across the animal kingdom is widespread, suggesting that it is an important feature not only of complex nervous systems such as the human one as initially believed but also of the simplest ones: even the nematode *C elegans* with only 302 neurons shows an asymmetrical distribution of some neurons. As lateralization expresses itself in a variety of behaviours such as the asymmetrical use of limbs and paired organs (e.g. eyes), investigating behavioural asymmetries in a comparative approach among different taxa has shown that behavioural asymmetries share a similar pattern in different species. Indeed, the left hemisphere is specialised in routine behaviours such as feeding, whereas the right hemisphere responds to unexpected stimuli like, for example, a potential predator.

The comparative research of this fascinating phenomenon has allowed a better understanding of the evolution and function of lateralized brains. In terms of fitness advantage, in fact, lateralized animals have been shown to outperform non-lateralized ones. However, for humans as well as for other species, there seems to be an optimal degree of lateralization that maximise the advantages connected with it in term of cognitive performance or fitness.

Another intriguing feature of lateralization is that it often manifests itself as a population-level bias, with most individuals aligned in the same direction.
If an asymmetrical brain confers advantages to a single individual because, for example, it is possible to process stimuli in parallel and to avoid competition between the right and the left sides of the brain in the control of response, it is harder to explain the function of the directional bias. Comparative research suggests that the alignment arises evolutionarily, when the need to coordinate an individual's behaviour with other individuals within the population became more and more important.