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Presentation title:

From planning to execution: Motor sequence control in the peri-movement phase

Abstract:

Motor planning is a key component of skilled motor control, particularly for skilled sequences of movements and its impairment can disrupt fluent goal-directed behaviour. Until recently, our knowledge of covert motor sequence planning in humans has been indirect, primarily derived from invasive recordings in animal models, computer simulations and behavioural markers during sequence execution. I will show how we can use multivariate pattern analyses of non-invasive neurophysiological (MEG/EEG), fMRI and muscular recordings, alongside a new behavioural paradigm to interrogate the structure and dynamics of motor sequence control in the period before and after movement execution. Across studies, we used a delayed sequence production task, where participant learned to retrieve and produce sequences of finger presses from long-term memory with accurate timing or as fast as possible after the Go cue. Our data suggests that sequence planning entails a parallel, rather than a serial pre-ordering of sequence elements. Further, it shows that the human brain automatically zips and unzips the order and

timing of well-trained movement sequences retrieved from memory into lower and higher level-representations trial-by-trial. This control mode may support behavioural transfer across task contexts and flexibility in the final hundreds of millisecond before movement execution. Together, our findings strongly favour a hierarchical and dynamic model of skilled sequence control across the perimovement phase with potential relevance to clinical interventions.

Short CV:

Dr Katja Kornysheva is an Assistant Professor and Co-Director of the Centre for Human Brain (CHBH) at the University of Birmingham, UK. Dr Kornysheva studies the physiological and informational processes underlying action planning and execution, sequencing and timing, as well as disorders of the latter. To address these goals her lab uses novel sequence learning paradigms in combination with brain, muscular and behavioural recordings (fMRI, MEG/EEG, EMG, dynamics, kinematics, motor timing) and neural pattern analyses. After a PhD in Psychology (2011; Dr. rer. nat., summa cum laude) undertaken at the Max Planck Institutes in Leipzig and Cologne, Katja commenced her Marie Curie Postdoctoral Fellowship at the UCL Institute of Cognitive Neuroscience in London. She was subsequently awarded the prestigious Sir Henry Wellcome Postdoctoral Fellowship in 2012 to study motor learning and timing in humans at UCL and rodent models in collaboration with the Neuroscience Department at the Erasmus Medical Centre Rotterdam. In July 2017, Katja joined the School of Psychology and Neuroimaging Unit at Bangor University as a Lecturer and subsequently transferred to the CHBH and the School of Psychology at the University of Birmingham in December 2021. Katja received the Academy of Medical Sciences Springboard Award in 2021 to study the neural basis of sequence planning in individuals with developmental coordination disorder (DCD)/dyspraxia.