

SFB/TR 8 Spatial Cognition / IQN Video Conference

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Mobile Brain/Body Imaging - A new method to investigate natural spatial cognition

Human cognition is embodied in the sense that cognitive processes are based on and make use of our physical structure while being situated in a specific environment. Brain areas and activities that originally evolved to organize motor behavior of animals in their three-dimensional (3-D) environments also support human cognition (Rizzolatti, Fogassi, & Gallese, 2002), suggesting that joint imaging of human brain activity and motor behavior could be an invaluable resource for understanding the distributed brain dynamics of human cognition. However, despite existing knowledge there is a lack of studies investigating the brain dynamics underlying motivated behaviors. This is due to technical constraints of other brain imaging methods, including functional magnetic resonance imaging (fMRI) and magnetoencephalography (MEG), that require the subject's head to remain motionless and are highly sensitive to movement artifacts. This imposes a fundamental mismatch between the bandwidth of recorded brain dynamics (now up to 10^6 bits/second or more) and allowed and recorded behavior (typically, minimal button presses at ~ 1 /second). To better understand the embodied aspect of human cognition, we have developed a mobile brain/body imaging (MoBI) modality to allow for synchronous recording of EEG and body movements as subjects actively perform natural movements in 3-D environments (Makeig et al., 2009). Simultaneous recording of whole-body movements and brain dynamics during free and naturally motivated 3-D orienting actions, combined with data-driven analysis of brain dynamics, allows, for the first time, studies of distributed EEG dynamics, body movements, and eye, head and neck muscle activities during active cognition *in situ*. The new mobile brain/body imaging approach allows analysis of joint brain and body dynamics supporting and expressing natural cognition, including self-guided search for and processing of relevant information and motivated behavior in realistic environments.

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