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Context Dependent Formation and Retrieval of Human Motor Memories

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Human can perform graceful movements using various tools under a wide variety of dynamical environments. This tremendous ability is achieved by the brain's function of constructing feed-forward movement controller (i.e., motor memory) based on the action experiences. In this talk, I will demonstrate that human can form and retrieve multiple motor memories for identical movements depending on different behavioral contexts (Ikegami et al., J Neurosci 2010; Hirashima & Nozaki, Curr Biol 2012) and that this redundant nature of motor memory enables us to perform flexible actions. For example, partly distinct motor memories are formed for identical reaching movements according to whether the opposite limb is stationary or moving (Nozaki et al., Nat Neurosci 2006; Nozaki & Scott, Exp Brain Res 2009) or with the movement directions of the opposite limb (Yokoi et al., J Neurosci 2011), which might contribute to compensate for the possible mechanical interaction between limbs when performing bimanual actions. Our current hypothesis is that the neural representations of identical movements are sometimes different among distinct behavioral contexts, and the motor memories are developed for each representation. I will also show the strong evidence that supports this idea: distinct motor memories can be artificially formed and retrieved for a reaching movement when the neural representation are manipulated using noninvasive brain stimulation.