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Increased gamma band power during movement planning coincides with motor memory retrieval

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Abstract
The retrieval of motor memory requires a previous memory encoding and subsequent consolidation of the specific motor memory. Previous work showed that motor memory seems to rely on different memory components (e.g. implicit, explicit). However, it is still unknown if explicit components contribute to the retrieval of motor memories formed by dynamic adaptation tasks and which neural correlates are linked to memory retrieval. We investigated the lower and higher gamma bands of subjects' electroencephalography during encoding and retrieval of a dynamic adaptation task. A total of 24 subjects were randomly assigned to a treatment and control group. Both groups adapted to a force field A on day 1 and were re-exposed to the same force field A on day 3 of the experiment. On day 2, treatment group learned an interfering force field B whereas control group had a day rest. Kinematic analyses showed that control group improved their initial motor performance from day 1 to day 3 but treatment group did not. This behavioral result coincided with an increased higher gamma band power in the electrodes over prefrontal areas on the initial trials of day 3 for control but not treatment group. Intriguingly, this effect vanished with the subsequent re-adaptation on day 3. We suggest that improved re-test performance in a dynamic motor adaptation task is contributed by explicit memory and that gamma bands in the electrodes over the prefrontal cortex are linked to these explicit components. Furthermore, we suggest that the contribution of explicit memory vanishes with the subsequent re-adaptation while task automaticity increases.

Keywords: Electroencephalography (EEG); Consolidation; Explicit memory; Force field; Sensorimotor learning; Reaching movement

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