

Error predictability across large-scale cortical activity

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The precise localizations and role of the neural substrates subserving inhibitory control are still debated. An intriguing hypothesis is that the performance of goal directed-actions and their suppression are not specified by independent sets of brain regions. Rather, acting and stopping might be functions emerging from specific interactions between largely overlapping brain regions, whose activity is intimately linked (directly or indirectly) to the evaluations of pros and cons of an action [1]. In line with this view, we have previously shown that the dorsal premotor cortex [2,3,4] and the primary motor cortex (M1, [2]) are involved in inhibitory function. In particular, recording from subdural electrodes placed over the lateral frontotemporal regions of one hemisphere of pharmaco-resistant epileptic patients, Mattia et al [2] showed that when a movement is successfully cancelled, an event-related potentials complex, whose onset precedes the end of the stop process, is selectively expressed in M1, Brodmann area (BA) 6, and BA9. Thus, it appears that the same regions that mediate voluntary decisions to act, are also involved in the voluntary decision to refrain from acting. In order to check whether other areas on the lateral frontotemporal surface take part to this process, we analyzed the frequency domain of the brain activity of the same patients. We developed a new analytical tool, based on principal component analysis, which allowed us to assess how well brain activity could distinguish between successful and unsuccessful trials, without selecting arbitrarily one or few contacts or frequency bands. On the one hand, we confirm our previous findings, as we found that the motor cortices (M1 and BA6) of both hemispheres distinguished successful from unsuccessful trials after the delivery of the stop instruction, but before the behavioral estimate of the time taken to react to the stop signal. On the other hand, we found that two areas of the inferior frontal gyrus (BA44/BA45) distinguished these two type of trials before the subject perceives the stop-signal. Overall, we did not find any sign of lateralization of the inhibitory network, however the sample was rather small (six subjects, three had the grid placed over the surface of the fronto-temporal lobes of the right and three over the left hemisphere), thus this finding has to be taken cautiously. The above result might be explained either by advocating a malfunctioning of the attentive system or the occurrence of wrong proactive computations when unsuccessful trials occur.

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