Testing the influence of various parameters on preparatory motor inhibition: a possible explanation for discrepancies between previous studies?

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Many transcranial magnetic stimulation (TMS) experiments have reported the presence of motor inhibition during action preparation. Most studies have used instructed-delay choice reaction time (CRT) tasks requiring subjects to select a response based on a preparatory cue, but to withhold that response until the appearance of a GO signal. Motor-evoked potentials (MEPs) are typically suppressed when probed during the delay period, close to the GO signal, and this effect occurs regardless of whether the muscle in which MEPs are elicited is selected (S) or non-selected (NS) for the forthcoming response. Although preparatory inhibition is very robust, some discrepancies have been observed regarding its strength. Several studies have reported a stronger MEP suppression when a muscle is S for the forthcoming movement, compared to when it is NS, while others have failed to replicate such findings, especially when MEP suppression is probed in the dominant hand. In that case, the effect is even reversed with smaller MEPs found in the NS than in the S condition. Most studies have used similar protocols, however with some small variations including the length of the delay period and its fixed or random duration, the percentage of catch trials (trials without a GO signal, no response expected), the time of TMS probes and the hand within which MEPs are elicited (dominant or non-dominant). In the present study, we aimed at investigating the impact of these different parameters on preparatory inhibition, with the goal to better comprehend the source of fluctuations in the strength of S and NS MEP suppression for dominant and non-dominant hand muscles. We used an instructed-delay CRT task that required participants to choose between left and right index finger responses. Based on previous studies, we focused on two representative delay periods (500 and 900ms, tested on separate days) that either had a fixed or a variable duration (tested in separate blocks). The percentage of catch trials was set to be either low (5%) or high (20%), again in different blocks. TMS was applied using a double-coil protocol. Hence, in each trial, MEPs were elicited in the two hands at a nearly simultaneous time (1 ms delay), allowing us to obtain probes of S and NS motor inhibition preceding dominant and non-dominant hand responses. MEPs were measured at one of three different timings during the delay period, and compared to those recorded at baseline (during the inter-trial interval). Globally, the strength of motor inhibitory influences increased over time, becoming strongest

around the time of the GO signal. In addition, a higher probability of catch trials (20%) was associated with a stronger motor inhibition at all TMS timings. However, surprisingly, this effect was only true for MEPs elicited from the non-dominant but not the dominant motor cortex, regardless of whether the probed muscle was S or NS for the forthcoming response. Finally, all effects were more marked when using the shortest delay (500ms) with a fixed duration. In conclusion, our results indicate that small differences in the task parameters, including the percentage of catch trials and the characteristics of the delay period, may impact significantly on motor inhibition measurements.