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TIMECOURSE OF PMD PROCESSING PREDICTS REACTION TIME

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The existence of "premotor processing" is suggested by experiments where instructed delays reduce reaction time (RT), presumably because they allow premotor processing before the go cue. Seeking a physiological basis of premotor processing, we recorded from dorsal premotor cortex (PMd) of two monkeys during a delayed reach task. Our analysis is based on a novel use of the fano−factor (FF). Typically used to gauge intrinsic spiking variability, we used the FF to factor out such variability, and isolate trial−by−trial variability in underlying firing rate. For each monkey, a low−noise estimate of the FF was made by averaging across all isolations and target conditions. Following target onset, the FF declined from ~1.3 to ~1.0 ($p<0.001$ per monkey). This effect was observed even when analysis was limited to target locations that evoked little change in mean firing rate. Our interpretation is that premotor circuits settle from their initial state (variable across trials) to a final state (consistent across trials) appropriate to drive the pending movement. The drop in the FF consumed >100 ms, suggesting that instructed delays reduce RT because premotor circuits take time to settle. Data were consistent with this view. For very short delays (30 ms), the decline in the FF occurred after the go cue. For longer delays (>200 ms) the decline occurred before the go cue. Consequently, the FF at the time of the go cue predicted mean RT across delay durations. Trial−by−trial variability in RT was also predicted by the FF: longer RTs were associated with greater firing−rate variability around the time of the go cue ($p<0.005$ per monkey). These data suggest that premotor processing is synonymous with the settling of activity to a state appropriate to drive the desired movement. The time consumed by this process appears to make a significant contribution to reaction time.

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