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Supplemental Information

**Causal Role of Motor Preparation
during Error-Driven Learning**

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Causal role of motor preparation during error-driven learning

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Supplemental Figures S1 - S3

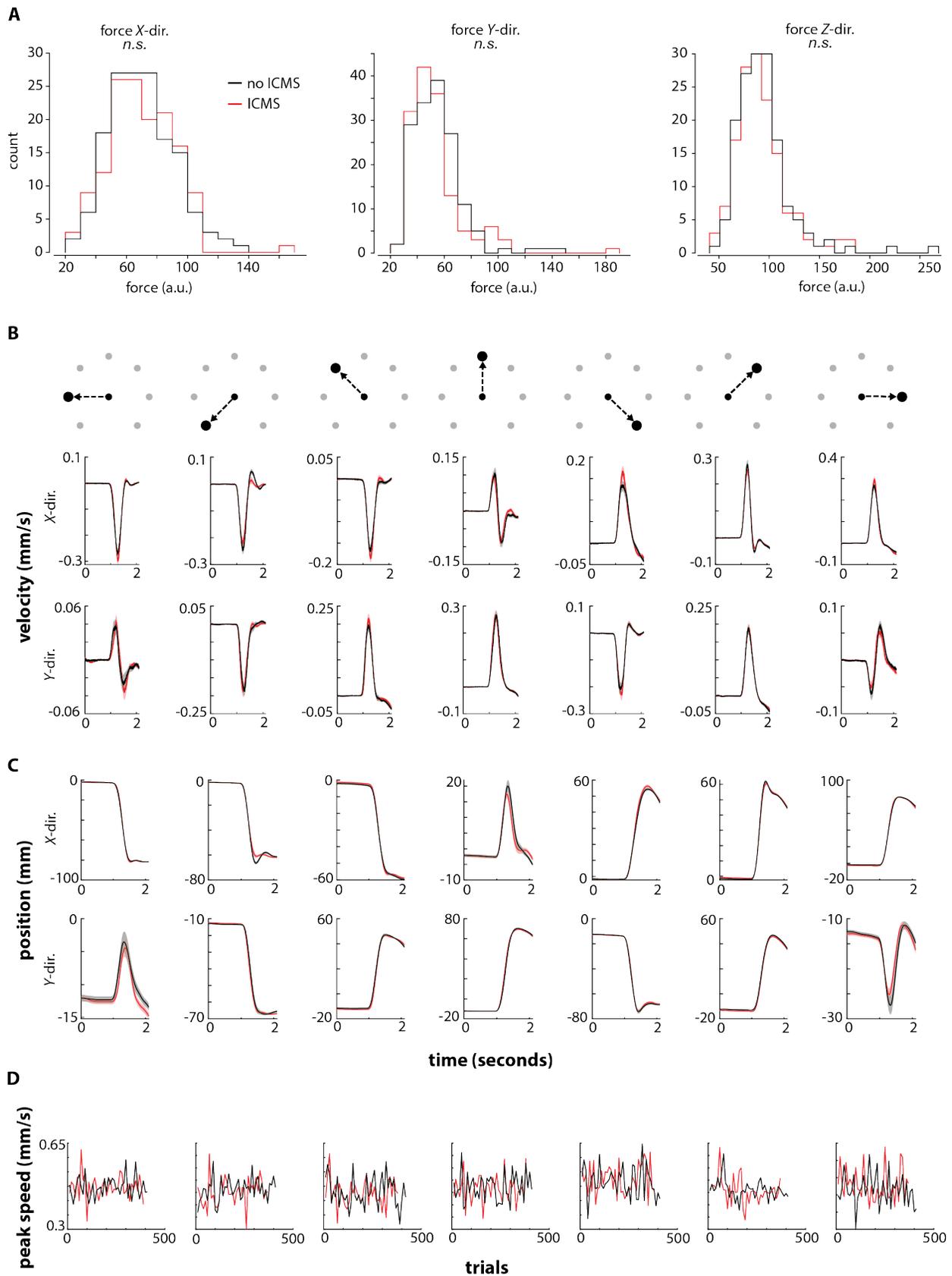


Figure S1. Related to Figure 4: Microstimulation is subthreshold and does not affect current trial behavior.

- A.** Histogram of forces measured at the hand and wrist using a load cell attached to the handle of the haptic device. Force is measured during a 200ms window around ICMS (including the 60ms of ICMS). The p -values were obtained from two-tailed Student's t -tests.
- B.** For each reach condition (top row, black circle shows condition) velocity profiles (mean and standard error of the mean) in the X and Y direction intra-trial. Red shows ICMS trials, black shows non-ICMS trials. No statistically significant differences are noted across groups.
- C.** Same as **(B)** but positions over time intra-trial.
- D.** Same as **(B)** but mean peak (i.e., maximum) speed plotted across trials for ICMS (red) and non-ICMS (black) conditions during a block of baseline (no VMR) trials.

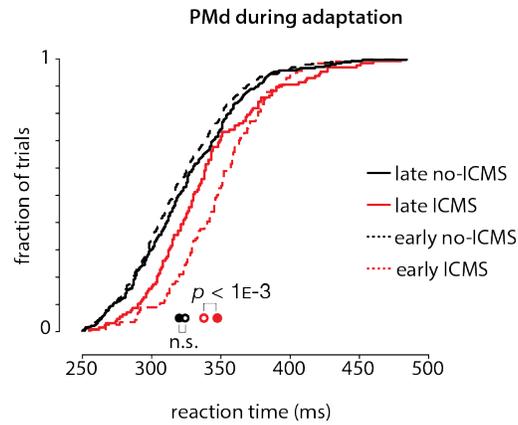


Figure S2. Related to Figure 4: Reaction time is slowed more by ICMS early versus late in learning.

Cumulative reaction time distributions (pooled across all sessions in PMd) for the ICMS (red) and non-ICMS (black) trials for Monkey P. Dotted red lines denote data from ICMS early (first 3 blocks) during adaptation compared to dotted black, which are the same number of non-ICMS trials early during adaptation. Solid red lines denote data from ICMS late (last 3 blocks) during adaptation compared to solid black, which are the same number of non-ICMS trials late during adaptation. ICMS was performed for an identical number of trials on all sessions. ICMS was performed either early or late during learning, never both. The p -values were obtained from the Wilcoxon rank-sum test and compare early ICMS (dotted red) with late ICMS (solid red), and early no-ICMS (dotted black) with late no-ICMS (solid black).

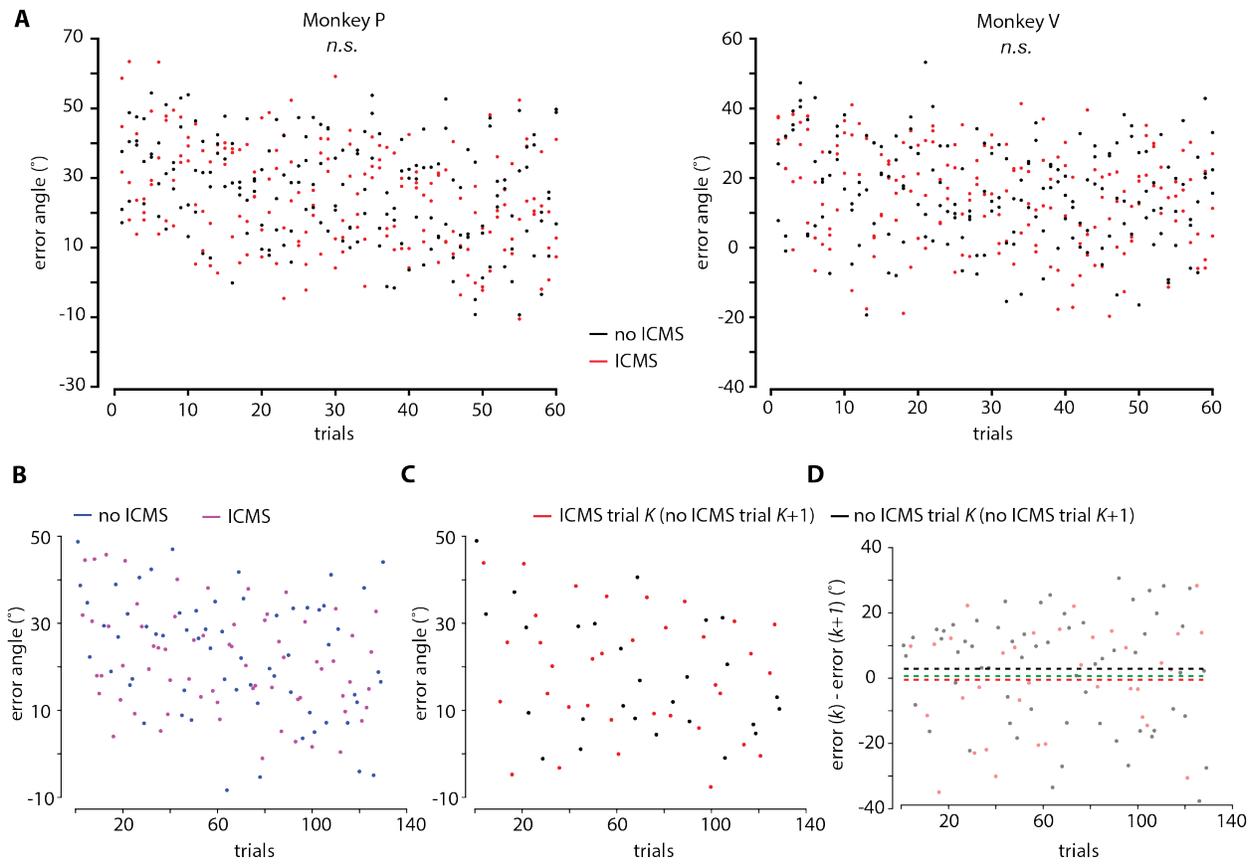


Figure S3. Related to Figure 4: Learning is disrupted following ICMS trials.

- A.** Error angle plotted a function of trials for ICMS (red) and non-ICMS (black) for all sessions for both animals.
- B.** Same as **(A)** but for one single representative session from Monkey P. Here, ICMS is magenta, and non-ICMS is in blue.
- C.** Trials from **(B)** are sub-selected such that red denotes ICMS trials following a non-ICMS trial, and black denotes non-ICMS trials following a second non-ICMS trial.
- D.** Data from **(C)** analyzed. Black dots show differences in errors between pairs of adjacent trials that are both non-ICMS. Red dots show differences in errors between pairs of adjacent trials, where the first trial (K) is ICMS, and the second trial ($K+1$) is non-ICMS. Red and black dotted lines are the means. The green dotted line is the mean trial-by-trial difference if all possible pairs of trials are considered (e.g., here we do not consider pairs of the form: ICMS & ICMS, no-ICMS & ICMS, etc.). This green dotted line matches the trial-by-trial difference for the data in **(B)** if condition is ignored. The red and black data are one session for the analysis from Figure 4E.