Title: Coding of intent in M1 and PPC: Array recordings in human clinical subjects for neural prosthetic applications

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Abstract: Individuals with spinal cord injuries resulting in paralysis are still able to think about and plan movements. These signals can be directly recorded from the brain to control external devices such as computers and robotic limbs, thus bypassing the injured spinal cord. Recent clinical studies have shown that regions in motor intact individuals that serve planning and action execution functions both enable neural prosthetic control. However, it remains unclear whether the natural functions of these regions are preserved. Here we report preliminary results from the first clinical study that directly compares how motor intentions are encoded in action execution (primary motor cortex, M1) and planning (posterior parietal cortex, PPC) regions of cortex. We recorded large populations of single neurons in M1 and PPC of a paralyzed individual taking part in a brain-machine interface clinical study. We find that under naturalistic control conditions, the functional roles of M1 and PPC are preserved, and emphasize execution and planning aspects of the task respectively. Neural population coding of intent is robust and largely independent of how visual information is used to cue intent. Interestingly, under certain experimental manipulations, we can subvert the natural coding of intent in these regions, in particular, we can experimentally induce “planning” like responses in M1. These dual recordings have enabled closed-loop neural prosthetic control that approximates the performance of motor intact individuals and furthers our scientific understanding of the motor control network.