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Neuroscience 2015

Presentation Abstract

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Presentation Title:	Multiple grasp types can be reliably decoded from the precentral gyrus in people with ALS using implanted intracortical electrodes
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Topic:	++D.18.c. Neuroprosthetics: Control of real and artificial arm, hand, other grasping devices

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Abstract: The BrainGate2 clinical trial has demonstrated that individuals with tetraplegia can control prosthetic limbs using neural signals processed from implanted electrodes in the precentral gyrus (Hochberg et. al. 2012). This work was recently expanded to high-dimensional prosthetic limb control (Collinger et. al. 2013, Wodlinger et. al. 2015). These studies used continuous decoding strategies for grasp control; however, an alternate approach for grasp decoding would be to discretely decode only the most common grasps used during everyday activities: the pinch, key and power grips. A discrete decoding strategy focused on these relevant grasps would have several benefits. First, such decoding strategies would not only provide a decoded command (i.e. the maximum-likelihood estimate) but also a level of confidence of the command; if a particular grasping action is detected with a high level of confidence, it can be enacted by an external effector without having to continuously control kinematic parameters on-line. Second, using a discrete decoding strategy could potentially allow releasing a grasp based on a generic hand-opening command vs. a grasp-specific command. The purpose of this experiment was to explore the feasibility of discrete grasp decoding and the potential advantages outlined above. Methods: Two research participants (T6 and T7) with amyotrophic lateral sclerosis (ALS) were implanted with Blackrock microarrays in the dominant precentral gyrus as part of the BrainGate2 clinical trial. In an open-loop block-randomized instructed-delay session paradigm, they were asked to "perform, or attempt to perform" one of four actions: power, pinch, or key grasp, or supination. Results: A total of 737 actions were analyzed for the two participants over five sessions. Raw spike rates were analyzed using a Gaussian Naïve Bayes classifier with 5-fold cross-validation. The action performed could be decoded with greater than 95% confidence during the action epoch. It was possible to decode the grasp-release state equally well using either a generic or grasp-specific class. Conclusion: Wrist supination and the commonly used power, key and precision grasps (the most common grasps used for daily activities) can be decoded with high accuracy from the precentral gyrus in humans. Triggering grasping movements based on high-confidence discrete classification of neural signals offers a robust and functional alternative to continuous control of hand kinematics for neuroprosthetic application, which could bring neural control of prosthetic devices closer to clinical utility.

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MOTOR CORTEX

ALS

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