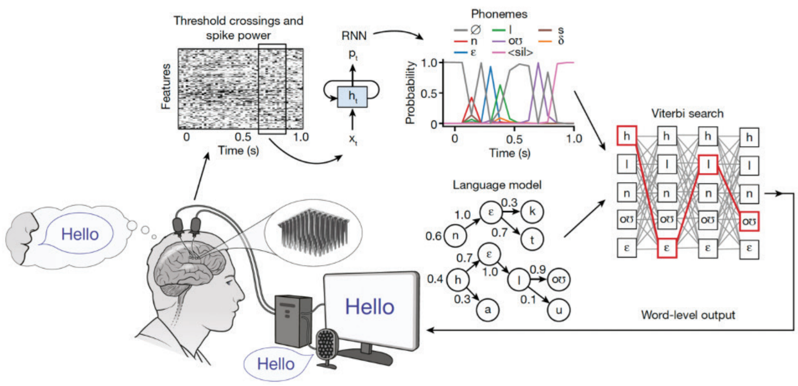

Neural activity recorded from speech-related areas of the motor cortex is separated into features associated with intended speech. A recurrent neural network identifies the most likely phonemes (building blocks of words) intended by the user. The order of these phonemes is then parsed into words which can be individually or sequentially refined using language models. The resulting output appears on a screen and can be made audible via text-to-speech. From Willett et al., Nature 2023

Implantable Brain-Computer Interface for Restoring Communication and Mobility

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Intracortical brain-computer interfaces (iBCIs) are poised to revolutionize our ability to restore lost neurologic functions for people with motor neuron disease (including ALS), stroke, and spinal cord injury. By recording high-resolution neural activity from the brain, intended actions (e.g., speech, movements) can be detected and decoded in real time for intuitive control of communication devices, assistive technologies, or one's own limbs.

Our investigational BrainGate system (braingate.org) comprises 4x4mm Utah arrays of up to 384 microelectrodes placed into motor-related areas of cortex. The arrays, which can enable years of chronic recording of ensembles of cortical neurons, detect action potentials and local field potentials associated with intentions to move or speak. Neural signals are transmitted to computers, which apply linear filters or machine learning to decode neural activity and control external devices. Trials by the multi-institutional BrainGate team have demonstrated an encouraging safety profile.

Over the past 20 years, clinical trials of the BrainGate system have demonstrated that people with tetraplegia can control a computer cursor, tablet computer, and other devices quickly and intuitively, simply by thinking about the movement of their own hand. More recently, the technology has been extended to speech decoding for people with profound dysarthria due to ALS, turning intended speech recorded from speech-related areas of the motor cortex into text displayed on a screen and made audible via computer-generated speech. Clinical trial participants with ALS have used the BrainGate system to 'speak' up to 62 words per minute. One BrainGate trial participant with a cervical spinal cord injury can switch between control of different computing devices (Windows PC, iPad) through a neurally controlled BrainGateHome (BGHome) app. He can also move his hand into different grasps using a BrainGate-enabled wearable, soft robotic glove. Our research continues to de-risk implantable neurotechnology for potential commercial translation.

Toward enabling the translation of personalized, neuroelectronic medicine technology, Mass General Brigham recently convened the first FDA-participating Collaborative Community in the clinical neurosciences: the Implantable BCI Collaborative Community (ibci-cc.org).