Connecting the Brain with Computers

People who have lost the ability to move or speak can now communicate using brain-computer interfaces (BCIs). The focus of BCI research so far has been on restoring gross motor skills, such as reaching and grasping and using a computer cursor. A team of researchers developed an intracortical BCI that decodes handwriting movements using neural activity in the motor cortex and translates them into text in real time, using recurrent neural networks (RNN). RNNs are able to accurately predict events by 'memorizing' parts of the input data. Speech recognition, translation, and more are based on these networks. With a general-purpose autocorrect, a participant whose hand was paralyzed by spinal cord injury achieved typing speeds of 90 characters per minute with 94.1% raw accuracy online and greater than 99% accuracy offline. They found these typing speeds to be higher than any other BCI, and comparable to typical smartphone typing speeds for our participant's age group (115 characters per minute). Studies like these demonstrate how cutting-edge neuroscience and computational innovation can be used to improve people's lives.

Reference: Willett, F. R., Avansino, D. T., Hochberg, L. R., Henderson, J. M., & Shenoy, K. V. (2021). High-performance brain-to-text communication via handwriting. Nature, 593(7858), 249-254.

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-Rohan Nath

Can you solve problems in your dream?

The short answer is yes! Many people experience their dreams as a hallucinatory world that feels as real as waking life. Dreams are yet to be adequately understood, yet they are emblematic of human sleep. When people recall dreams they can be distorted and forgotten, which poses a fundamental challenge to neuroscientific studies of dreaming. Researchers found that individuals who are asleep and in the midst of a lucid dream can perceive and provide answers to questions posed by an experimenter using electrophysiological signals. Sounds like it's straight out of the movie Inception?! The researchers presented simple math problems and yes/no questions to study participants using Morse code and verbal communication, and several of them correctly answered using previously established eye signals. Participants were also capable of performing veridical perceptual analysis of novel information, storing information in working memory, computing simple answers, and expressing volitional responses during REM sleep. Direct perception of stimuli in their original form is called veridical perception. For example, through the various sense organs, individuals receive information that allows them to perceive their "reality" and orient themselves accordingly. Dreams can be explored empirically using this relatively unexplored communication channel.

Reference: Konkoly, K. R., Appel, K., Chabani, E., Mangiaruga, A., Gott, J., Mallett, R., ... & Paller, K. A. (2021). Real-time dialogue between experimenters and dreamers during REM sleep. Current Biology, 31(7), 1417-1427.