Predicting your thoughts using mine

What are you thinking about right now? If I was sitting across from you, I could use your body language and clues based on the situation to make a good guess. Better yet, I could use your brain activity.

Deciphering thoughts, feelings and intentions from brain activity has been a central pursuit in neuroscience since it began. With technological advances, neuroscientists have built sophisticated methods to extract information from signals zipping around the cortex. The main approaches used today harness machine algorithms that learn a kind of map, one which connects specific brain signals to specific mental states. When the algorithm is shown a new brain signal, it consults its map to make a prediction about what the signal means.

But this approach has its limits. A major bottleneck is that brain activity representing a particular thought can vary across people. This means that for a machine algorithm to predict what you are thinking, it needs *a lot* of data from *your* brain to build a reliable map. To predict whether you are thinking about chocolate or puppies, the algorithm would need to see your brain responses to chocolate or puppies tens if not hundreds of times. As a result, current methods for reading your thoughts are limited to very specific cases, with the ability to decipher your innermost secrets so remote they exist only in science fiction.

But what if these limits could be removed? What if neuroscientists didn't need large amounts of data from your brain to predict your thoughts, feelings or intentions. What if they could use data from my brain or the brains of other people, to make good predictions about the mental experiences unfolding inside you?

This is where cross-brain decoding comes in. Cross-brain decoding involves building machine algorithms that learn the mapping between neural signals and mental content from someone else's brain. The algorithm can then be used to infer what you are thinking, without the need to show you chocolate and puppies hundreds of times. A key ingredient in unlocking this new approach has been for scientists to develop special ways of processing brain signals, transforming and converting the information so that it becomes more easily relatable across people.

A major motivation for cross-brain decoding is to improve brain-computer interfaces, devices that are used when people have lost access to their limbs through injury or illness.

Imagine someone left paralyzed by a car crash, someone for whom a brain-computer interface could dramatically improve their quality of life by allowing them to control the movement of a wheelchair. A key technical challenge raised in cases like this is how a device can learn to understand brain signals for behaviors that never occur. How can a device learn to predict movements, such as the downward motion of the arms needed to propel a wheelchair, when those movements never actually happen? This is where cross-brain decoding offers a promising solution. Devices could learn to interpret brain signals from people with full movement capabilities, where there is a clear connection between particular brain signals and particular actions. The device could then be used to infer intended actions for people who are unable to carry out certain movements, feeding this information into external aids, such as wheelchairs or prosthetics.

Cross-brain decoding could affect our lives outside the medical domain too. Without the need to show you chocolate and puppies hundreds of times before being able to predict when you are thinking of them, companies could effectively build a huge database of brain signals for different thoughts, feelings and motivations. This could be used to predict a much wider range of mental states, with much less brain data from an individual, than other brain reading algorithms. These insights might even be used to supplement social media data, helping companies identify when people are more receptive to certain products. Fortunately for consumers, a world where this is possible – if it is possible – looks distant. For one, there would also need to be big breakthroughs in devices that measure brain activity, so that they are cheap, portable and sensitive enough for widespread use in society. Given how predictable we are based on our clicks and likes, the cost and complexity of algorithms that decipher information across different peoples' brains hasn't whet the appetite of big business, at least for now.

Cross-brain decoding is just in its infancy. Yet, this new approach to sketching our mental landscape holds huge promise for improving people's lives, through brain-computer interfaces that give people more freedom after injury or illness. Bound up with this promise, cross-brain decoding has a long road ahead, before its beneficial applications will come to full fruition. Maybe one day I'll be able to tell what you're thinking using a brain reading device that has been trained with signals from my own brain. Until then, I'll have to use your body language and clues from the situation to make my best guess.

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References

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