

Brain imaging reveals the movies in our mind

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This set of paired images provided by Shinji Nishimoto of the University of California, Berkeley on Wednesday, Sept. 21, 2011 shows original video images, upper row, and those images reconstructed by computer from brain scans. While volunteers watched movie clips, a scanner watched their brains. And from their brain activity, a computer made rough reconstructions of what they viewed. Scientists reported that result Thursday, Sept. 22, 2011 and speculated such an approach might be able to reveal dreams and hallucinations someday. In the future, it might help stroke victims or others who have no other way to communicate, said Jack Gallant, a neuroscientist at the University of California, Berkeley, and co-author of the paper. (University of California, Berkeley, Shinji Nishimoto)

Imagine tapping into the mind of a coma patient, or watching one's own dream on YouTube. With a cutting-edge blend of brain imaging and computer simulation, scientists at the University of California, Berkeley, are bringing these futuristic scenarios within reach.

Using [functional Magnetic Resonance Imaging \(fMRI\)](#) and computational models, UC Berkeley researchers have succeeded in decoding and reconstructing people's dynamic visual experiences – in

this case, watching Hollywood movie trailers.

As yet, the technology can only reconstruct movie clips people have already viewed. However, the breakthrough paves the way for reproducing the movies inside our heads that no one else sees, such as dreams and memories, according to researchers.

"This is a major leap toward reconstructing internal imagery," said Professor Jack Gallant, a UC Berkeley neuroscientist and coauthor of the study to be published online Sept. 22 in the journal *Current Biology*. "We are opening a window into the movies in our minds."

Eventually, practical applications of the technology could include a better understanding of what goes on in the minds of people who cannot communicate verbally, such as stroke victims, coma patients and people with neurodegenerative diseases.

It may also lay the groundwork for brain-machine interface so that people with cerebral palsy or paralysis, for example, can guide computers with their minds.

However, researchers point out that the technology is decades from allowing users to read others' thoughts and intentions, as portrayed in such sci-fi classics as "Brainstorm," in which scientists recorded a person's sensations so that others could experience them.

Previously, Gallant and fellow researchers recorded brain activity in the visual cortex while a subject viewed black-and-white photographs. They then built a [computational model](#) that enabled them to predict with overwhelming accuracy which picture the subject was looking at.

In their latest experiment, researchers say they have solved a much more difficult problem by actually decoding brain signals generated by moving

pictures.

"Our natural visual experience is like watching a movie," said Shinji Nishimoto, lead author of the study and a post-doctoral researcher in Gallant's lab. "In order for this technology to have wide applicability, we must understand how the brain processes these dynamic visual experiences."

Nishimoto and two other research team members served as subjects for the experiment, because the procedure requires volunteers to remain still inside the MRI scanner for hours at a time.

They watched two separate sets of Hollywood movie trailers, while fMRI was used to measure blood flow through the visual cortex, the part of the brain that processes visual information. On the computer, the brain was divided into small, three-dimensional cubes known as volumetric pixels, or "voxels."

"We built a model for each voxel that describes how shape and motion information in the movie is mapped into brain activity," Nishimoto said.

The brain activity recorded while subjects viewed the first set of clips was fed into a computer program that learned, second by second, to associate visual patterns in the movie with the corresponding brain activity.

Brain activity evoked by the second set of clips was used to test the movie reconstruction algorithm. This was done by feeding 18 million seconds of random YouTube videos into the computer program so that it could predict the brain activity that each film clip would most likely evoke in each subject.

Finally, the 100 clips that the computer program decided were most

similar to the clip that the subject had probably seen were merged to produce a blurry yet continuous reconstruction of the original movie.

Reconstructing movies using brain scans has been challenging because the blood flow signals measured using fMRI change much more slowly than the neural signals that encode dynamic information in movies, researchers said. For this reason, most previous attempts to decode [brain activity](#) have focused on static images.

"We addressed this problem by developing a two-stage model that separately describes the underlying neural population and blood flow signals," Nishimoto said.

Ultimately, Nishimoto said, scientists need to understand how the brain processes dynamic visual events that we experience in everyday life.

"We need to know how the brain works in naturalistic conditions," he said. "For that, we need to first understand how the [brain](#) works while we are watching movies."

More information:

Current Biology: <http://www.cell.com/current-biology>

Movie reconstructions: <http://bit.ly/nzm9Tw>

Provided by University of California - Berkeley

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