NEUROSCIENCE AND PSYCHOLOGY
Published: 20 June 2025
doi: 10.3389/frym.2025.1508144

BEHIND THE SCENES: USING MOVIES TO STUDY THE HUMAN BRAIN

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YOUNG REVIEWERS:


JULIA
AGE: 9


NETTIE
AGE: 13


SUSAN
AGE: 9

What happens inside your brain when you watch your favorite movie? Maybe you wonder what the character thinks or wants to do next? Since characters in movies often act like we do in real life, scientists can use movies as "experiments" to study how our brains work. In this article, you will learn about how scientists have examined people's brains, using a technique called functional magnetic resonance imaging (fMRI), while the people were watching movies. These experiments help researchers learn about what different parts of the brain do and how brain regions work together in both adults and young children. Movie fMRI experiments have made it more fun to take part in studies and have helped researchers learn how the brain works in "real life" as well as in people who find it hard to take part in other types of fMRI experiments.

WHY USE MOVIES TO STUDY THE BRAIN?

People spend a lot of time trying to understand the world around them. How do our brains help us do this? To learn more about the brain, scientists use a tool called functional magnetic resonance imaging (fMRI) to measure **brain activity** while people think. When a person uses a region of their brain, blood flows into that area. FMRI uses a magnet to pick up on changes in blood flow into different parts of the brain and to make pictures of brain activity. Scientists can use brain pictures taken by fMRI to understand which parts of the brain are being used.

For a long time, most fMRI experiments were really simple—they compared brain activity while people thought about different things (Figure 1). For example, participants would read or listen to stories about people's thoughts and emotions and to other stories, called **control** stories, for comparison—like stories about people's bodies and actions (Figure 1C). Scientists noticed that some brain regions were more active in response to the stories that were about people's thoughts and emotions than to control stories. Many experiments like this have found special brain regions or groups of brain regions (called networks) that help us do particular things, like look at faces, read, and think about others' thoughts and feelings.

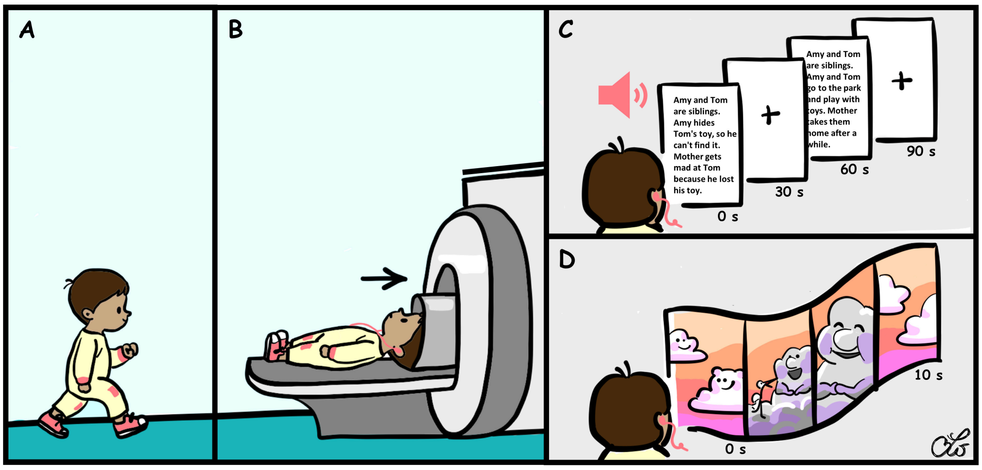

Figure 1

This kind of "traditional" fMRI experiment is really useful, but it might not be the best way for scientists to ask all the questions that they have about the brain. First, these experiments are very hard for young children to do because they are usually long and boring. Participants have to think about the same kinds of things over and over again. It is hard to pay attention and stay still for that long, and some people even fall asleep! Second, this kind of experiment might not always show how the brain works "in real life". Reading a story about a person's thoughts might be different from interacting with a person and trying to understand what they are thinking or feeling.

FUNCTIONAL MAGNETIC RESONANCE IMAGING (FMRI)

A technique that measures blood flow to study brain activity. People lay still in a large, donut-shaped machine (called a scanner) and have brain pictures taken while they do experiments.

BRAIN ACTIVITY

Brain cells communicate with electrical and chemical signals. Brain cells sending signals need energy, so blood flow in the brain is a sign of brain activity.

CONTROL

Stories (or pictures) that do not have the thing being studied (e.g., faces) but are otherwise similar to the thing being studied. Controls are used for comparison.

Figure 1

Traditional vs. movie-viewing fMRI experiments. **(A, B)** A child gets into an MRI scanner, which scientists use to measure brain activity. **(C)** In a traditional fMRI experiment, the child might listen to stories about characters thinking (mind stories) or doing actions (control stories). **(D)** In a movie-viewing experiment, the child watches a movie that shows characters thinking or doing actions.

Problems like these led scientists to study brain activity during movie viewing (Figure 1D) [1]. Movies are fun to watch, even for young children, and they are a little more like real life than many traditional fMRI experiments. When people watch a movie, they think in ways that are like how they think in the real world: they try to understand the characters and the world they live in and guess what will happen next. Because of this, movie-viewing experiments are great for learning about the brain.

WHAT HAVE WE LEARNED FROM MOVIE-VIEWING EXPERIMENTS SO FAR?

In one of the first studies to use movie fMRI experiments, adults watched full-length movies while getting their brains scanned using fMRI [2]. The researchers tested which movie scenes led to high activity in particular brain regions. They found that when faces were shown, like in close-ups of two people talking, brain regions that process faces were really active. These brain regions were first discovered with traditional fMRI experiments that used pictures of faces and control pictures of objects, bodies, and houses.

MIND NETWORK

A group of brain regions used for thinking about other people's mental states (e.g., thoughts, emotions, desires). These brain regions work together and do similar things.

Another study used a short cartoon movie and the same kind of analysis to study the **mind network**, which is a group of brain regions used to think about people's thoughts, wants, or emotions (Figure 2) [3]. These researchers found that the mind network was active when adults had to think about the characters' thoughts—for example, to understand why they acted a certain way, or to understand the interactions between two characters. Together, these studies suggest that movie experiments are another way to learn about the brain.

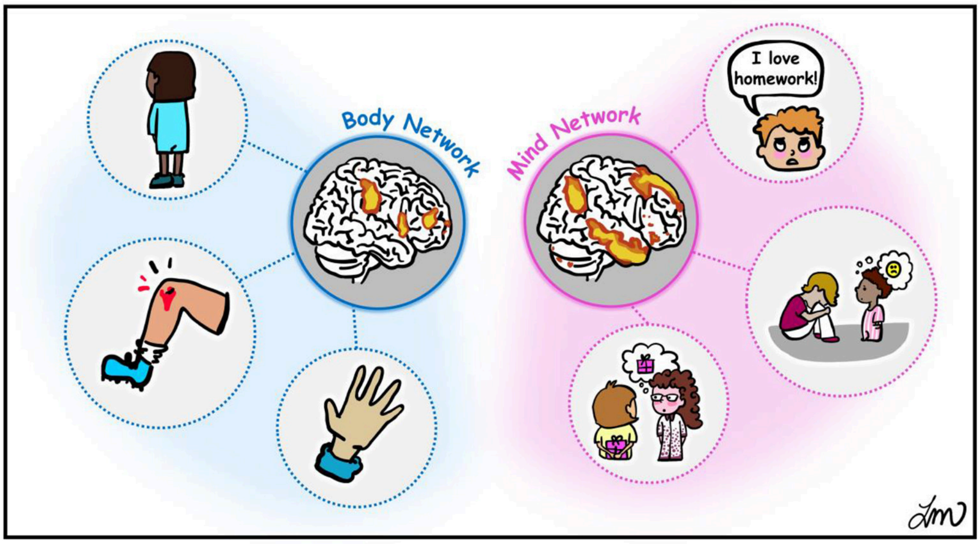

Figure 2

Figure 2

The body and mind brain networks. The body network (blue) includes the parts of the brain that are used to think about people's body movements and feelings (e.g., pain, hunger) and the mind network (pink) includes brain regions used to think about people's mental states (e.g., thoughts, wants, and emotions).

Movie fMRI experiments can also be used to learn about which brain regions *work together* as a network. For example, scientists found that different brain regions within the mind network had really *similar* activity during the movie, and really *different* activity from brain regions called the **body network** that are used to think about others' bodies (Figure 2) [3]. This is because the brain regions in these two networks were active during different parts of the movie (Figure 3).

BODY NETWORK

A group of brain regions used for thinking about bodies (e.g., muscle movements or bodily feelings like pain). These brain regions work together and are well connected.

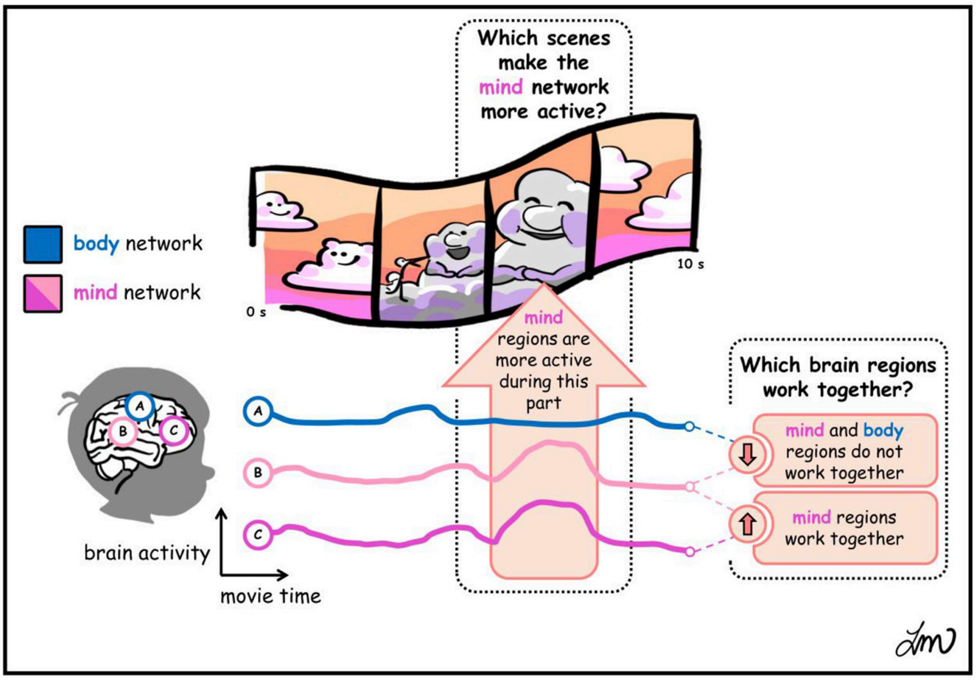

Figure 3

Figure 3

A child watches a movie. Brain region A (blue) is in the body network and regions B and C (pink) are in the mind network. Scientists can find parts of the movie where a brain network or region is more active. Here, activity in the mind network (regions B and C) is highest at a specific movie scene (cloud laughing). Scientists can also measure how similar activity is between brain regions. During the movie, the activity in body and mind regions is quite different, as they are part of two different networks. However, activity in regions within the mind network (regions B and C) is really similar.

Kid Brains are Like Adult Brains and Get More "Adult Like" With Age

Studies using movie-viewing fMRI experiments in adults helped scientists feel ready to use these experiments to study the brains of very young children, like 3-year-olds, who often find it hard to take part in traditional fMRI experiments.

One research team used the same short movie used for adults to study the mind network in 3–12-year-old children [3]. They found that brain activity in the mind network of 3-year-olds was a lot like that in adults: it responded to the same parts of the movie—parts about people's thoughts and emotions—and different regions in the mind network worked together when watching the movie. As children got older, brain activity in the mind network looked even more like adults' brain activity. Children who were better at answering questions about people's thoughts and emotions after the fMRI experiment had more "adult-like" brain activity in the mind network during the movie.

Scientists have also used movie fMRI experiments to study the development of other skills in children. Researchers used clips from the TV show *Sesame Street* to study brain regions that help children do maths [4]. Just like in adults, specific brain regions activated when Elmo talked about numbers. This brain activity was stronger in older children and in children who scored higher on maths tests.

When People Watch a Movie Together, Their Brains Can "Sync Up"

Another cool thing that researchers have found using movie fMRI experiments is that peoples' brains "sync up", or show similar activity, when they watch the same movie! This is not too surprising because brain regions that help us see and hear the movie work basically the same way in most people. However, people watching the same movie might think about or remember different things. This means that brain regions used for understanding the characters—like the mind network—and brain regions used for memory might be less in sync across people. One research team did an fMRI experiment where adults watched a short movie with shapes moving and interacting with one another [5]. People who understood the movie in the same way had more similar brain activity, especially in the mind network. Think back to the last time you went to the cinema. Your brain activity was synced up with all the other brains in the room watching the same movie, but it was probably most similar to your sibling or best friend, who you share lots of memories and ideas with.

CONCLUSION

Using movie-viewing fMRI experiments, researchers have learned about how certain brain regions work. They have also learned how brains work differently as children get older and across people with different ideas and memories. This kind of research has built on what researchers already knew about the brain from traditional fMRI experiments, helping them understand how the brain works in real life, even in very young children. In short, movies can be more than just good entertainment—they can be a powerful way to study the brain!

ACKNOWLEDGMENTS

We would like to thank Carmen Bonich and Mingen Luo for thoughtful contributions during the write-up of this article.

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SUBMITTED: 08 October 2024; **ACCEPTED:** 21 May 2025;
PUBLISHED ONLINE: 20 June 2025.

EDITOR: Rajesh Kumar Kana, University of Alabama at Birmingham, United States

SCIENCE MENTORS: Nathan A. Jorgensen and Cameron S. Mang

CITATION: Jiménez-Sánchez L, Thye M, Abel S, Bhatt N, Mckinnon K, Rubin R, Skelton J, Smikle R, Vaher K and Richardson H (2025) Behind the Scenes: Using Movies to Study the Human Brain. Front. Young Minds 13:1508144. doi: 10.3389/frym.2025.1508144

CONFLICT OF INTEREST: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

YOUNG REVIEWERS

JULIA, AGE: 9
Julia loves to ask questions about anything and everything. In her spare time, she works on inventions in her lab (i.e., her bedroom) and follows a do-it-yourself gymnastics training plan. Along with her big sister, Etta, she has fun learning, challenging herself, and exploring the outdoors on family backcountry hiking trips.

NETTIE, AGE: 13

Hello! I am Nettie! I am an avid learner and reader, especially murder mysteries. Some things I like are art, nature and hiking. I want to be either a neuroscientist or a midwife when I grow up, and would also like to be a professional cyclist.

SUSAN, AGE: 9

Hi, I am Susan! I am in third grade. I love reading all sorts of books, especially fantasy. I want to be an author when I grow up. I also love cats and dragons, and books about cats and dragons. My favorite thing to do is play outside.

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