The secret is in the slightly different view seen by each of our eyes. Known as binocular vision, our eyes see the world from different angles, so the images they perceive are slightly different. Specific neurons in our brains respond to the differences between these two images, enabling the brain to build a more accurate view of how objects in our environment relate to one another. We are not born with the ability to interpret those differences, however; that must be learned.

“We use the difference between what the two eyes see to provide information on 3D shapes. But how does the brain learn to do this?” says Hibbard.

For their research, Hibbard and team took two approaches. They first used machine learning to understand how the neural networks required to interpret the image differences could form. The team also used a 3D laser scanner to create images of everyday objects, allowing the researchers to collect precise information about the object. These images were shown to participants and used to understand which factors contributed most to our ability to perceive objects in 3D.

For this part of the project, the researchers created a library of 3D images and sophisticated ways of handling computer graphics to produce 3D scenes. The advent of modern VR technology provided Hibbard and colleagues with a new way to examine depth perception using their image library, leading to the establishment of their VR lab.

“It’s a much more natural form of vision than looking at flat images on a computer screen, so we started doing that,” Hibbard explains.

UK researchers are working with Facebook Reality Labs, the augmented reality and virtual reality (VR) team within social media giant Facebook, to better understand how our brains interpret what we see to produce a three-dimensional (3D) representation of our world. The research is contributing to the development of modern VR technology, such as that used in the Oculus Rift headset produced by Facebook.

Seeing in three dimensions

Our ability to perceive depth is enormously useful. A 3D view of the world lets us reach and grasp effectively, move more confidently through our environment, and judge distance – all important survival skills. But how do we perceive our surroundings in 3D, when the images received by our eyes are two dimensional?

Virtual reality technology aided by binocular vision research

The secret to seeing 3D is the slightly different view seen by each of our eyes, known as binocular vision. Image: Paul Hibbard, University of Essex.

IMPACT SUMMARY

BBSRC-funded researchers at the University of Essex are collaborating with researchers at Facebook Reality Labs to study how people judge distance, which will help researchers develop and refine virtual reality technology.

The collaboration builds on research supported by BBSRC to understand how our brains learn to perceive the world in three dimensions.

The team won one of just three awards from Facebook for vision research. The research is contributing to the development of modern VR technology, such as that used in the Oculus Rift headset produced by Facebook.

The Facebook collaboration also led to the researchers’ involvement in the creation of a VR experience to accompany a play, The Mystery of the Raddlesham Mumps, based on a poem by BBC poet-in-residence Murray Lachlan Young.

More immersive VR

Virtual reality, which enables participants to explore a 3D computer-generated environment usually by wearing a specially designed headset, together with related technologies such as augmented reality, all rely on our understanding of how human vision works. Several companies are developing VR headsets for consumers, and a better understanding of binocular vision will help them develop more immersive and believable virtual environments.
In 2017, Facebook Reality Labs, formerly Oculus, announced a competition to fund fundamental vision research projects. Van Dam and Hibbard applied, along with Dr Peter Scarfe from the University of Reading. The team won one of just three grants that were awarded.

Working with researchers at Facebook Reality Labs, Hibbard and team are now examining the cues people use to gauge distance. “We’ve been looking at how good people are at judging distance,” says Hibbard. “What can you get away with leaving out? What’s the minimum required to do that in VR?”

**A narrative experience**

“We’ve also been working with a theatre company to develop VR to go alongside a play; that collaboration arose from the Facebook funding,” Hibbard explains. “Beyond the pure fun of collaborating on such an interesting project with such keen, professional and committed people - was the way the VR element opened up areas of the story and production concept that had not been thought of before the interaction with Paul and his team,” says Lachlan Young.

The story is told across a book, an album, the play and the VR experience. The VR, developed with funding from Research England, allows audiences to engage with the main character of the play and the play’s setting as they arrive at the theatre, before seeing the performance.

“For a University, participating in collaborative projects with industry gives our research real world application and impact,” says Emma Wakeling, Knowledge Exchange Manager at the University of Essex. “Carrying our research into the audience experience of VR which includes a family setting really excites us as we get to explore how this affects the dynamic and enhances the overall experience of the artistic piece. The other worldly nature of Raddlesham Mumps lends itself to a VR representation and the end result heightens user’s immersion into the tale.”

The play had its first run in London and the east of England in April 2019. The researchers are now collecting data on the effectiveness of the VR for audience members.

According to Theatre Producer Matthew Linley, “For us developing the VR prequel of The Mystery of the Raddlesham Mumps for Oculus Go has been a real game changer. At a simple level it provided a fun, unique and innovative experience in foyers which our audiences loved. More profound than that it’s challenged us to explore different ways of storytelling, ways more suited to a 3D experience. We’re already thinking of new projects which push forward our learning from Raddlesham Mumps and test some of the findings from Professor Hibbard’s ground-breaking research.”

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