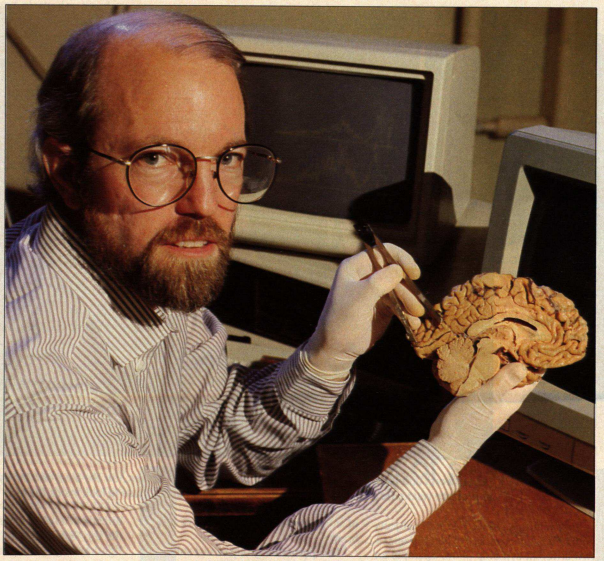

Dr. Steve Hackley, assistant professor of psychology, is pointing to part of the brain called the visual cortex. Nerve impulses from the eye travel along the optic nerve to the visual cortex where they are translated into the images we see.

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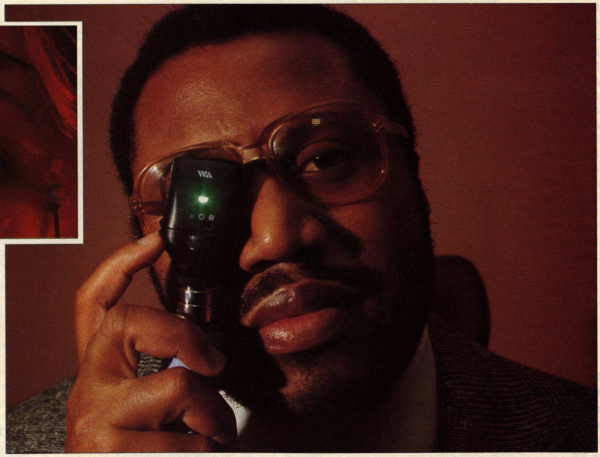
The seeing blind

story by John Beahler
photos by Rob Hill

Medical researchers call it "blindsight." Scientists can't tell you exactly how it happens, but sometimes, on a subconscious level, some blind people can "see."



Sensors taped to the eyelids and scalp of graduate student Noelle Wood record how quickly her brain reacts to the flash of a strobe light.

Dr. Lenworth Johnson, associate professor of ophthalmology, studies how the brain and the eyes work together to produce vision. He's holding an ophthalmoscope, which doctors use to look inside the eye.

In scientific studies, research subjects with blindsight are asked to identify one of two different symbols — for example an "X" or an "M." They might tell researchers that they can't see, but when forced to make a guess they somehow can answer with remarkable accuracy. In fact they're almost as accurate as people who have not lost their sight.

The phenomenon only occurs in a select group of blind patients. Some of them have had strokes when the blood flow was blocked to their brain. In others, tumors or head injuries caused blindness.

In all these cases the visual cortex was damaged. The visual cortex is a small area in the back of the brain that translates nerve impulses from the eyes into vision. Their eyes are still normal and continue to send messages to the brain, but that part of the brain no longer can translate the information.

Two Mizzou scientists are exploring the pathways of human vision, and they're working with these blindsight patients to better understand the complicated network of connections that link the eyes to the brain.

This particular group of test subjects is blind only on one side. That's because the visual cortex is divided into two parts, and each part of the cortex controls the vision on one side of the body. In these patients, only half of the visual cortex has been damaged.

Some other undamaged part of their brains — perhaps the brain stem — is unconsciously processing visual messages, says Dr. Steve Hackley, assistant professor of psychology.

Hackley and Dr. Lenworth Johnson, associate professor of ophthalmology, are trying to trace those unconscious pathways.

Scientists know that the eyes and the brain work together to produce vision. Just like the most advanced computer, your eyes break down each visual image into millions of pieces of information. That information is converted into electrical impulses which are sent to the visual cortex. Here's how the process works:

Every time you blink your eyes and look at something, hundreds of millions of cells go to work. Some raise and lower the eyelids. Others move the eyeball to look directly at an object. Still other cells adjust the tiny lens in the pupil of the eye to let light rays inside and form a sharper image on the retina.

If you compare the human eye to a camera with lenses and shutters, then the retina, located at the back of the eyeball, is like photographic film. Each human retina consists of nearly 120 million photoreceptor cells which are activated when light enters the eyes. Then other specialized cells in the retina sort out information about size, color, light and movement.

"The retina is able to convert light energy into an electrical as well as a chemical type of signal," Johnson says. That information is sent on to the brain through bundles of nerve fibers called the optic nerve.

"The visual system is one of the most complex systems in the human body," Johnson adds. "Nearly 40 percent of the nerve cells going into the brain pertain to vision."

Hackley is studying how blindsight patients react to visual stimulus — a flash of light. The subjects blink in response to

the bright light, and electrodes taped to their eyelids and scalps measure the brain waves and muscle activity that are generated in response.

"We don't always know where these reflexes and brain waves come from," Hackley says. "I hope our research helps us make some conclusions about what circuits in the brain are involved."

By timing the brain waves, researchers learn how quickly the brain reacts when the eyes send messages about the flashing lights. That can tell the scientists where in the brain the information is sent.

For a person with normal vision it takes about 30 milliseconds — 30 one-thousands of a second — for the eyes to send a message to the visual cortex. "We will check the reflex reaction time of the blindsight patients, and if the reflex happens more quickly than 30 milliseconds then we know the information didn't go through the cortex," Hackley explains.

By comparing different reactions between the patients' blind side and sighted side, the researchers can infer which parts of the brain produce the reflexes and brain waves.

So if these visual messages don't make it to the cortex, where are they ending up? Hackley and Johnson think that one possibility is an area lower in the brain, called the brain stem. Scientists know that as the optic nerve travels back to the cortex, some of the nerve fibers branch off to the brain stem.

The brain stem keeps track of many of the body's reflex activities — like blood pressure and heart rate and breathing. Hackley says that the brain stem may be the location of blindsight.

If their research confirms that theory, then scientists have succeeded in mapping another section of the human nervous system.

How can map making help others? Currently, doctors rely on brain scans to pinpoint damage to the brain from strokes and other disease. "Sometimes the brain quits working, or won't work right, and you can't find the reason on a brain scan," Hackley says. "This information can be used as a diagnostic tool to test visual pathways."

Johnson calls this blindsight study basic research. "Although we are studying real people, we can't apply the results of our research to help others right away." But Johnson hopes that, in the long run, blindsight research will improve the quality of life for everyone.

Finding your blind spot

Even people with normal vision have a blind spot. That's because the eye cannot detect light that falls on a certain place in the back of your eye where the optic nerve is attached. The optic nerve connects the eye to the brain.

To find your blind spot, close your left eye, and use your right eye to stare at the "O." Keep your eye on the "O," and slowly move the page closer or farther away from your face, within a range of about 2 to 8 inches. At a certain distance, the "X" will disappear. That's because the light from it is going to the blind spot in your eye.

If we're all blind in that spot, why doesn't it look black? The reason is that the brain fills in this empty region according to whatever color or shape is next to it. In some ways, blindness is similar. To blind people the world does not look black — like on a dark night. They just aren't aware of light.

O X

Pathways of sight