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Scientists Gain Insight From Man's Vision

By Rob Stein

When the doctors unwrapped the bandages, Michael May was stunned: He could see shadows and shapes, and, after scanning the fuzzy images around him, make out his wife's blue eyes and blond hair for the first time.

May, who had been blinded by a chemical explosion at age 3, had undergone an experimental procedure the day before in the hopes of restoring his vision. But after more than 40 sightless years, he had expected it would take weeks to find out whether he would be able to see the world again.

"It was pretty amazing," said May, 49, of Davis, Calif. "We were all in shock. It worked much sooner than anyone had thought. Immediately it was like, 'Look at that. Look at that. Look at that.' "

May is one of only a handful of people who have had their vision restored after virtually a lifetime of blindness and the only person whose experience of returning to the visual world has been thoroughly studied. The procedure that repaired May's vision in 2000 remains relatively unusual and works in only a small percentage of cases. But May's unique experience is providing profound and unprecedented insights into how vision works, the flexibility of the human brain and how people learn to interpret the world around them.

"It's an unbelievably rare opportunity," said Ione Fine of the University of Southern California, one of a pair of researchers who have been studying May. Her first findings were published online yesterday by the journal Nature Neuroscience. "It's very, very rare."

May's case has begun to answer such questions as: Is the ability to see hard-wired in the brain, or is it learned after birth? How flexible is the brain's ability to learn new skills and use the same neurons in new ways? How much of what we call vision is determined by the signals that come in through the eye compared with how the brain interprets those signals?

The operation fully restored May's visual capabilities, meaning he can "see."

But, at least so far, his brain's ability to interpret and understand those signals remains far from normal.

He can catch a ball, for example, but he can't recognize his wife's face. He can only tell a cube is a cube if it's moving. He recognizes colors perfectly and can weave his way through a crowd without his guide dog or cane. But he often can't tell shadows from trees.

His experience strongly suggests that humans are born with some visual abilities, but probably not all of them, and that some visual skills come more readily than others. Although the brain can be reprogrammed, that capacity may be limited. And the brain may lose certain capabilities if they lie dormant long enough.

"This tells one about the plasticity of the brain -- how it adapts to an unusual situation -- in this case having no images coming in from the eye," said Richard Gregory, an emeritus professor of neuropsychology at the University of Bristol in England. "We now know that there is considerable vision that is available immediately, then there's a long period of learning to make sense of the images."

May's case has also shown that the ability to see can sometimes make life more difficult instead of easier.

"This case shows the human drama of coming to terms with the world of sight," said Gregory, who studied 40 years ago what had previously been perhaps the best-documented similar case. "It's not simple. Some people get very depressed -- they expect too much. Some get confused by what they're taking in. It's a very interesting human and psychological situation."

May has adjusted well, but he says regaining vision has not changed his life dramatically. Given a choice between seeing and going to the moon, he would opt for a trip into space. "Lots of people can see and tell you about it. But how many people can tell you that they've been to the moon?" May said.

May was blinded when chemicals he was playing with exploded, destroying his left eye and burning the surface of his right eye. He was left without sight except for the ability to sense night from day.

He went on to lead a full life, becoming an expert skier, marrying, fathering two sons and founding a successful company that makes navigation systems for the blind.

Then, on March 6, 2000, he underwent a relatively new procedure in which stem cells were transplanted onto the surface of his right eye in the hope they

would replace the scar tissue that made a cornea transplant impossible. May's left eye had suffered too much damage to be repaired.

The procedure has been performed on hundreds of people worldwide but on only a few who have been blind most of their adult lives.

After the procedure and a cornea transplant, tests showed that May's eye works perfectly. What now fascinates and perplexes researchers is that three years later, May still sees the world largely "like an abstract painting," Fine said.

He can discern motion, two-dimensional forms and color. "That was the most amazing thing. Initially I hadn't thought about color. To all of a sudden have the faucet turned on for this whole world of colors, it was amazing. Somewhere in the recesses of my mind was the ability to discern colors," May said in a telephone interview.

What he can't do is recognize objects in three dimensions, make sense of complex landscapes, recognize faces or interpret facial expressions.

Fine and Donald MacLeod of the University of California at San Diego have conducted a battery of tests. Brain scans showed that the part of the brain that becomes activated in sighted people when they see faces and objects remained dormant in May. But when he looks at an object that is moving, the motion detection part of his brain lights up with activity.

The findings suggest that certain visual skills, such as detecting color and motion, are more hard-wired and develop earlier in infancy than others.

"My own view is that motion processing develops very young. It had time to stabilize. So when the lights went out, it kind of sat there and waited," Fine said.

The ability to process complex forms such as objects and faces may not fully develop until later and may require continual stimulation to function fully, because people need to be able to recognize new objects and changes in faces throughout their lives, she said. "We have to recognize new images throughout time. That system is much more plastic throughout our lives. The price for that is that if you switch the lights out, it kind of disintegrates over time. It's a system that needs stimulation."

Because May went blind before his brain had a chance to develop this capacity, it may forever be out of reach for him.

Slowly, May has been able to learn how to interpret some of the new information his brain receives. When he first tried to ski with his restored

vision, he found it frightening and difficult because the images confused and distracted him.

"All of a sudden when I could see all this stuff my heart was in my mouth. I was falling. I wasn't turning when I was supposed to be turning," May said.

He could ski only with his eyes closed. But since then, he has begun learning how to interpret some of what he is seeing. "I've been learning over time how to use it and when it's helpful and when it's not helpful. My processing speed has gotten quicker," May said.

He has also learned how to catch a ball and can follow the general outlines of a baseball game.

May still cannot recognize faces, including his wife's. He relies on cues such as hair length and color, height and gait to guess who someone is.

"The difference between today and [three] years ago is that I can better guess at what I am seeing," May said. "What is the same is that I am still guessing."

Although May's ability to interpret the new information is improving, Fine said, "I think he'll always kind of 'speak' vision as a second language. He'll never be fluent. He doesn't seem to be able to learn the rules of grammar of the visual world. He's learning the individual sentences in the same way a second language learned will never be learned fluently."

In that way, "this shows us, really almost for the first time, with unusual clarity how difficult it is to relearn this process or learn it from the outset," said MacLeod, Fine's colleague. "The lesson from Mike's experience is really not very encouraging. Mike's progress up to now has been rather modest. And if he can't do it, nobody can."

Although vision has not dramatically changed his life, May said it has enhanced it.

"The first time the experience of having vision brought tears to my eyes was in a very unexpected situation. It was at a parade. I was sitting with my boys watching a parade and getting all this visual information and it sort of hit me all at once -- this is amazing," he said.