

Study shows formerly blind can learn to see

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How does the human brain "learn" to see? If the brain is deprived of visual input early in life, can it later learn to see at all? MIT researchers are exploring those questions by studying some unique patients--people who were born blind, or blinded very young, and later had their sight restored.

Doctors have long believed that children who were blind during a "critical period" early in life had little hope of learning how to see even if vision were later restored, so they were reluctant to offer potentially risky surgical treatments such as cataract removal to children older than 5 or 6.

However, in a recent case study, the MIT researchers found that a woman who had her vision restored at the age of 12 performed almost normally on a battery of high-level vision tests when they studied her at the age of 32. The study appears in the December issue of *Psychological Science*.

The new research "shows that the brain is still malleable" in older children, says Pawan Sinha, senior author and associate professor of brain and cognitive sciences at MIT. This knowledge could benefit thousands of blind children around the world, particularly in developing nations, who were previously thought to be too old to receive eye treatment.

The MIT researchers found their case study subject in India, where childhood blindness is a huge problem, and where Sinha recently

launched a humanitarian initiative, Project Prakash, to help expand the reach of eye care facilities.

About 450,000 children in India are blind, and many of those cases are preventable. Most of the affected children live in remote areas where eye care is not available, so conditions that could be easily treated, such as cataracts, vitamin A deficiency or conjunctivitis, often lead to blindness.

In many such cases, blindness can be deadly: Blind children in India have a 15-year-shorter life expectancy than sighted children, and half of them die before the age of 5, according to Sinha. "Blindness essentially hastens death," he said. Some blind children are able to go to school, but "many live out their lives entirely dependent on other people's charity."

Through Project Prakash (Prakash means "light" in Sanskrit), the MIT researchers are making eye care available to blind children who would otherwise go untreated. The project has both humanitarian and scientific benefits--after treatment, the researchers study the children's progress, gaining insight into how the brain learns to see.

In the Psychological Science paper, the researchers studied a subject they encountered serendipitously--a 32-year-old woman who had had her sight restored at the age of 12. Known by her initials, S.R.D., the woman is the first subject of this kind who has been extensively studied, but there are other patients like her in India, says Yuri Ostrovsky, first author of the paper and a graduate student in brain and cognitive sciences.

Before her surgery, S.R.D. could distinguish between light and dark but could not make out form or pattern. Twenty years after the surgery, S.R.D.'s visual acuity was only 20/200, but the researchers were surprised to find that she showed normal or near normal abilities on most

tests of high-level vision, including recognizing objects and faces, judging depth order and matching 2-D and 3-D shapes.

One task where she did not do well was the gaze-estimation test, where she based her answers on where people's heads were pointed, not where their eyes were looking. She also seemed to take longer to perform some of the tasks, and she had trouble visualizing objects with her eyes closed, said Ostrovsky.

S.R.D. had no explicit training after her surgery, so she had to learn by experience. Because of the 20-year lag between her sight restoration and initial testing by the researchers, they don't know how much time it took her to reach her present level. "It's hard to get the full picture," said Ostrovsky.

Still, the findings have significant implications for the idea of a "critical period" for learning how to see, says Sinha. There are few data from human subjects regarding such a critical period, but studies with other animals such as kittens have suggested that visual recovery is very limited following a few initial months of rearing in complete darkness. Extrapolating these findings to humans would lead one to conclude that treating blind children after a few years of age would be of very limited use.

However, evidence from the case of S.R.D. and others suggests that the visual cortex retains its plasticity, or ability to learn new functions, well into childhood.

Those early results have already had an impact on how doctors view childhood blindness. Ophthalmologists working with the MIT team in India are now more willing to treat older patients, which they previously thought would be hopeless.

"Before our collaboration with them, they would be very reluctant to treat children older than 5 or 6 years of age, but now they are much more willing to identify older children and treat them," Sinha said.

After completing their case study, the researchers received the distressing news that S.R.D. had met with an accident while taking her 9-year-old daughter to the eye clinic. She fell while getting off a bus and was pulled under the wheels, and died of her injuries. The researchers plan to contribute funds to help her daughter, who is now living by herself in a hostel for the blind, and other blind children who often end up neglected by society.

MIT graduate student Aaron Andalman of brain and cognitive sciences is also an author on the Psychological Science paper. The research was funded by the Merck Scholars Fund and the National Eye Institute.

In other ongoing studies, the researchers hope to track the precise order and mechanism of visual skill development following sight restoration.

Source: MIT

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