Neuroscience sleuths are on the case of face blindness, a strange malady that makes some people unable to distinguish friend from foe.

Imagine that an eccentric psychologist accosts you. In his hand is a piece of paper with 20 pictures of roses. One of the pictures shows a rose in the flower bed you just passed, he says, and he asks you to pick its picture out from his lineup. The challenge would seem absurd—but if you were to change the roses to faces, nearly everyone could meet it.

Most of us have a powerful ability to recognize faces, and yet we hardly ever take note of it. We can commit a face to memory with a single viewing, and even if we see that face only once its memory can stay fresh for years. The faces we remember so easily may differ only in subtle tweaks of geometry: the ratio of distances between different landmarks such as the eyes and the mouth, for example.

A small fraction of people, however, cannot recognize faces—even the faces of their parents, spouses, and children. Prosopagnosia, as this condition is known, can affect people from birth or be triggered later in life by injuries to the brain. It strikes an estimated 2 percent of Americans and is often accompanied by other types of recognition impairments, including difficulty recognizing places and objects, such as cars.

Despite the millions of people who suffer from prosopagnosia, it remains an obscure disorder, probably due to the skill with which face-blind people quietly compensate for their condition. In his new book, The Mind’s Eye, neurologist and writer Oliver Sacks makes the surprising disclosure that he has prosopagnosia. “I have had difficulty remembering faces for as long as I can remember,” he writes. Sacks, who turns 78 this year, has been publishing books for four decades. Despite his many years in the public eye, this is the first time most of his fans have learned of his condition.

Doctors can’t do much for people with prosopagnosia, in part because neuroscientists still have only a rough idea of how normal face recognition works. Recently, cognitive neuroscientist Marlene Behrmann at Carnegie Mellon University and her colleagues gathered some important clues to this puzzle by comparing the brains of individuals who are face-blind to those who are face-sighted. Their results hint at how we recognize faces: not in a flash of insight, as it may seem, but by building up recognition on a neurological assembly line.

Behrmann has been testing a model for face recognition that was first proposed 25 years ago by Tim Valentine and Vicki Bruce, two psychologists at the University of Nottingham in England. Valentine and Bruce argued that our brains do not store a photographic image of every face we see. Instead, they carry out a mathematical transformation of each face, encoding it as a point in a multidimensional “face space.”

On a map of face space, you might imagine the north-south axis being replace with a small-mouth-to-wide-mouth axis. But instead of three different dimensions, like the space were familiar with, face space may have many dimensions, each representing some important feature of the human face. Just as the ancient cosmos was centered on Earth, Valentine and Bruce argued that the facial universe is centered on the perfectly average face. The farther a face is from this average center, the more extreme it becomes.

Over the past quarter century, the face space model has gained the support of a number of neuroscientists. For one thing, it offers an elegant explanation for how we can store so many images of faces in our heads. By reducing a face to a point—creating a compact code for representing an infinite number of faces—our brains need to store only the distance and direction of that point from the center of face space. Face space also sheds light on the fact that we are more likely to correctly identify distinctive faces than typical ones. In the center of face space, there are lots of fairly average faces. Distinctive faces dwell far away from the crowd, in much lonelier neighborhoods.

Face space also explains why the favorite trick of editorial cartoonists works so well. By exaggerating features on a politician’s face—Bush’s eyebrows, Obama’s ears—cartoonists push it farther away from the center of face space, to places where it has less competition from other faces we have stored in our memory. As a result, we recognize people from hand-drawn caricatures as quickly as from photographs—and sometimes even more quickly.

In addition to explaining the experiences we are familiar with, face space also explains a particularly bizarre illusion called the facial aftereffect. It’s similar to what happens when you stare for a long time at a picture of, say, an American flag. If you then look at a blank wall, you’ll see a ghostly afterimage of the flag in reversed colors for a few seconds. Much the same thing happens if you stare at a face for a long time. When you look at another face, it will look a little like the opposite version of the face you just stared at.

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