The fundamental mechanisms of facial recognition

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When it comes to recognizing faces, humans are extraordinarily skillful. It's no surprise – after all, from the moment humans leave the womb, the infant brains already have a preference for faces, and over the course of a lifetime, the average person sees hundreds of thousands of faces.

Among scientists, however, the question of exactly how humans came to possess this amazing ability remains a divisive one, with some researchers claiming our extraordinary abilities result from the operation of mechanisms specialized just for faces, whereas others argue that recognition of any visual categories with which we acquire expertise (e.g., faces, cars, birds) depends on the same mechanisms.

Using tests conducted with patients suffering from prosopagnosia, or

"face blindness," Harvard and Dartmouth researchers have taken a step toward resolving that dispute.

The study, published this week in the *Proceedings of the National Academy of Sciences*, showed that patients with prosopagnosia learned as well as the average person to become experts at distinguishing between highly similar exemplars of new objects. However when asked to learn a set of faces under the same conditions, the prosopagnosics did very poorly. The findings point to the idea that prosopagnosia is the result of damage to a brain mechanism specifically devoted to processing faces.

"What we wanted to do was to test a key prediction of the "expertise" hypothesis," said Constantin Rezlescu, a Post-Doctoral Fellow in Psychology and the first author of the study. "The expertise hypothesis predicts that when there is impairment in facial processing, you should also see impairment in processing other objects of expertise, because if the mechanisms are the same, any damage should affect both faces and other objects. Our findings, however, show a clear dissociation between participants' ability to recognize faces and their ability to recognize other objects with which they became experts in recognizing."

To test the expertise hypothesis, Rezlescu and colleagues recruited two patients with face blindness, and trained them to become experts in recognizing a set of 20 computer-generated objects designed to engage the brain in the way the faces do.

Called greebles, the objects can be grouped into "families" based on their body types, and each greeble shares a limited number of slightly different appendages arranged in a common configuration. To identify any single greeble, Rezlescu explained, participants must recognize those subtle differences, similar to the way humans recognize slight differences in faces.

"These are very commonly used in psychology," Rezlescu said. "One of their major uses is to investigate this expertise hypothesis…because supposedly it only takes people seven to 10 hours of training to become expert at recognizing them."

While most people can initially quickly identify greebles by family – because each has a specific body shape – to become an "expert," he explained participants must practice until they can identify individuals equally fast.

After testing patients with face blindness and a group of control test subjects on how well they recognized both faces and greebles, Rezlescu said, the results were unequivocal.

When it came to recognizing greebles, he said, patients with face blindness performed as well as the control group. Both patients, however, struggled to recognize faces, and scored far below other participants.

"What we found is that prediction – which is a fundamental prediction of the expertise hypothesis – does not hold," Rezlescu said. "That provides indirect evidence that there may be some specific mechanism for processing faces, although it doesn't prove it directly. Our conclusion is that the expertise hypothesis, at least that relying on greeble studies, is false."

Rezlescu, however, pointed out that the question of whether expertise acquired in the lab is truly equivalent to real-world expertise remains open.

"In the real world, you may have experience for 10 years or more with objects that you become an expert on," he said. "It is an open question whether the two kinds of expertise – that gained in the lab and that

gained in the real world – are comparable. But it is important to note that a great deal of the evidence that was claimed to support the expertise hypothesis comes from studies involving greebles, and what we found is that cannot be true."

Going forward, Rezlescu and colleagues plan to explore predictions related to the hypothesis that the brain has specific mechanisms for recognizing faces. He also hopes to understand how the brain recognizes identity, and how information gathered from other sources – such as voices – are somehow integrated in the brain.

What's clear, he said, is that understanding faces, and the social cues they convey, are an enormously huge part of what it ultimately means to be human.

"Faces are extremely rich social stimuli" Rezlescu said. "We extract so much information from faces that we need for our day-to-day interactions. We need to be able to understand them to function."

More information: "Normal acquisition of expertise with greebles in two cases of acquired prosopagnosia," by Constantin Rezlescu, Jason J.S. Barton, David Pitcher, and Brad Duchaine.
www.pnas.org/cgi/doi/10.1073/pnas.1317125111

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