Abstractions

FIRST AUTHOR

Humans and monkeys can distinguish between faces in a fraction of a second, seemingly without conscious effort. The neuronal mechanisms of recognition are unclear, so, while working at the Max Planck Institute for Biological Cybernetics in Tübingen, Germany, David Leopold investigated them (see page 572). Using trained monkeys, he and his colleagues monitored individual neuronal responses in a part of the brain involved in visual recognition while the monkeys viewed and responded to composite images. Leopold, who is now at the US National Institutes of Health in Bethesda, Maryland, tells *Nature* about this work.

Why take on this topic?

Because facial recognition is a remarkable, swift and effortless process. It allows us to rapidly navigate a wide variety of social situations, and is important for both survival and reproduction.

What was it like watching the monkeys responding to the images?

The role of the neurons was not clear during the experiments; the monkeys were simply viewing a series of randomly ordered faces on a monitor, then moving levers to select which faces most resembled each other. Afterwards, we put the faces in order and compared the variations in facial identity with the neuronal signals. This was exciting, because we realized that single neurons in this part of the brain respond in a highly systematic way to very small variations in facial characteristics.

What do the monkeys' response speeds say about the nature of recognition?

Their responses were almost mechanistic, and so fast that the monkeys wouldn't have had much time to think about which face was which.

What is the importance of the 'average' face in this paper?

It seems that single neurons in our brains compare new faces with an internally stored 'prototype' face, which is the average of faces we have seen before. This is important, because for us to understand face recognition, we have to consider that the neurons aren't encoding all the details of a face; they are encoding the deviations from a stored reference. This average face is something you or the monkey has accrued with experience.

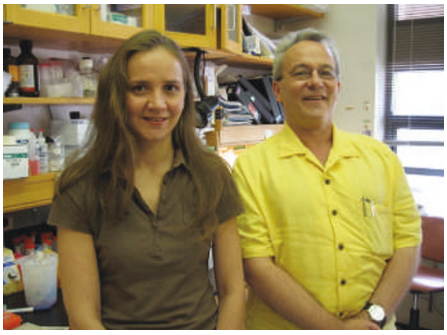
What's next?

We'd like to look at the neuronal basis of learning in primates, and how the average neuronal representation of faces and other complex objects comes about. ■

MAKING THE PAPER

Ihor Lemischka

Intensive search reveals the genes behind stem cells' flexibility.



Ihor Lemischka (right) with Natalia Ivanova.

Embryonic stem cells can develop into almost any type of cell. What cues prompt this remarkable transformation? This was a question that Ihor Lemischka, a molecular biologist at Princeton University in New Jersey, was keen to answer. He wanted to find out more about the genes that determine when and how mouse stem cells differentiate and renew, hoping that this information would one day be useful for human stem-cell-based therapeutics.

Lemischka's group opted to use RNA interference (RNAi), an increasingly popular technique for selectively reducing the function of individual genes. "We wanted to study whole ensembles of gene products at the same time and not be limited by the complications of traditional genetics approaches," he says.

Lemischka's group, led by postdoc Natalia Ivanova, began by using microarrays to identify gene products required by embryonic stem cells to remain as stem cells. They looked for genes that are rapidly turned off after the cells begin to diversify, reasoning that these genes were potentially crucial to this process. The screen yielded 900 candidate genes. The researchers focused on the 65 genes that encoded transcription factors, which are known for their role in development, and five other genes of interest from previous work.

As reported on page 533, they used RNAi to knock out the function of each gene, one at a time. Next, they monitored how well the cells continued to divide. Ten genes seemed to have an important role, seven of which were particularly active.

The group found seven genes that are required by mouse embryonic stem cells for efficient self-renewal *in vitro*. In particular, they were interested in how other genes would be affected when these transcriptional regulators were inactive.

More than three years ago, Lemischka became intrigued by the potential for systems-biology approaches. He hopes, one day, to identify the heart of the stem cell's 'self-renewal machine', and then to tweak the system by modulating levels of gene products. "We're really at the very, very beginning of understanding how this works," he says. As part of a collaboration with researchers at Cold Spring Harbor Laboratory in New York, he is expanding his search to find proteins that give mouse embryonic stem cells the ability to develop into so many cell types.

The next step will be to move into human embryonic stem-cell work. Lemischka says the federally approved US embryonic stem-cell lines will probably be sufficient at this stage; he would prefer to avoid the extra costs and effort involved in setting up a separate lab to study privately funded cell lines. Although his methodology will transfer to human systems, the differences that might exist between mouse and human embryonic stem cells remain unclear. But comparing stem-cell differentiation in the two species should provide some interesting insight into developmental biology — and perhaps help to translate that work to clinical treatments. "It's an absolute thrill to think that something we're doing with mouse stem cells might actually impact on clinical medicine in the future," Lemischka says.

He adds that he has found the lab work so exciting that he's considering spending more time at the bench. "It's a scary thought for people in the lab," he jokes. ■

THEORETICAL CONTRIBUTOR

A post-conference conversation about the interplay between theory and experiment launched a friendship and then a collaboration between two physicists in 1999.

The work of theorist Alexander Balatsky, based at Los Alamos National Laboratory in New Mexico, and experimentalist Séamus Davis, of Cornell University in New York, has focused on high-temperature superconductors — in which the lattice structure influences electron behaviour.

At the time the pair met, many in the field believed most irregularities reported in these lattices to be a "nuisance or a distraction", says Balatsky. Initially, he took the same view, but, he adds, "while working with Séamus, I changed my mind".

Since then, he and Davis have found evidence that these irregularities are more extensive at the nanoscale than was previously thought. Balatsky used a mathematical model to estimate where such irregularities might be, and Davis developed imaging techniques to find them.

Their most recent work (see page 546) investigates the influence of 'holes' in the lattice on the formation of electron 'pairs', which are essential to superconductivity.

Their conversation, in search of how and why this happens, will continue. ■