

► Steed, a computer scientist who heads a virtual-environments group at University College London.

He and Slater have been experimenting for more than a year with early prototypes of the HTC and Oculus devices, and say that the performance is just as good as that of higher-end devices, and getting better. The new devices are light enough to be worn for extended periods, and they react quickly to the user's movement, preventing the motion sickness that can occur when using VR. "Two to three years ago, the lab we used for our research cost €100,000 [US\$114,000] to set up. Now we can do the same for about €4,000," says Slater.

For years, Slater has run VR experiments with psychologists, including one that tested how white people's biases change after they have virtually inhabited the body of a black person.

Last week, Slater and Daniel Freeman, a clinical psychologist at the University of Oxford, UK, and their collaborators published a study that suggests that VR could help to treat people with severe paranoia, who often avoid crowded places because of a perception that other people want to hurt them (D. Freeman *et al.* *Br. J. Psychiatr.* <http://doi.org/bgrr>; 2016). The experimental therapy attempts to teach people

to lower their defences and to trust others by letting them visit virtual environments such as crowded lifts or underground trains.

Other studies have used VR to try to treat post-traumatic stress disorder and fear of heights or spiders. These experiments used expensive, high-end gear, but several of the researchers involved say that they now plan to start using consumer headsets instead.

As well as being cheap, the headsets are simple to set up. "It's a proper out-of-the-box experience," says Steed. If larger studies prove the therapies to be effective, patients could borrow the equipment and use it at home, Freeman says.

Neuroscientist Elizabeth Buffalo at the University of Washington in Seattle is also considering how to use the Oculus Rift. Her team studies monkeys as the animals explore interactive environments that are represented on a screen. Head-mounted sets that create a 3D environment would create a more immersive, and therefore natural, experience, she says, but current products are too big to fit on a monkey's head. "We are working on hacking the Oculus to achieve this," Buffalo says.

Creating complex virtual environments still requires specialized computer skills, says Slater. But costs are falling now that some

software developed to aid video-game companies is free to use, and many labs outsource the work. A related technology called augmented reality (AR), which superimposes images onto the user's field of view rather than replacing the scene with a different one, could also be of use in the lab, helping researchers to visualize and share data sets, says Mark Billinghurst, who studies human-computer interaction at the University of South Australia in Adelaide.

Google Glass, an early attempt at AR that projected images into the corner of a pair of glasses, was a commercial flop, but Microsoft is about to launch a more sophisticated AR headset called HoloLens. "With AR technology like HoloLens," says Billinghurst, "researchers could easily see a complex virtual data set superimposed on a real table in front of them, and also see each other face to face across the table and talk about the data."

Mary Whitton, a computer scientist who works on virtual environments at the University of North Carolina at Chapel Hill, says that there is still room for improvement in the way the systems track users' motions and in how users can interact with the virtual world using their hands. Still, she says: "I've had most fun seeing how people use what we've built in ways we never imagined." ■

## GENOMICS

# Gene variants linked to education prove divisive

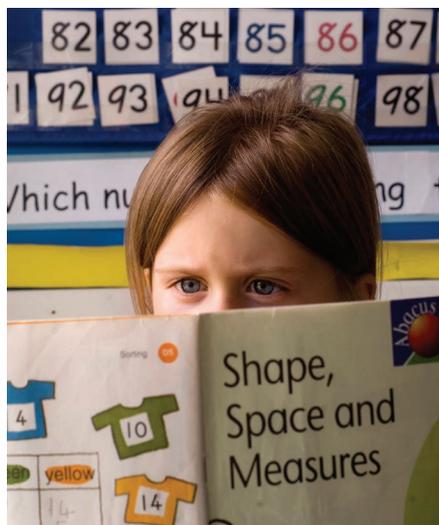
Study uncovers 74 genetic markers that influence the number of years spent in education.

BY ERIKA CHECK HAYDEN

The largest-ever genetics study in the social sciences has turned up dozens of DNA markers that are linked to the number of years of formal education an individual completes. The work, reported this week in *Nature*, analysed genetic material from around 300,000 people.

"This is good news," says Stephen Hsu, a theoretical physicist at Michigan State University in East Lansing, who studies the genetics of intelligence. "It shows that if you have enough statistical power you can find genetic variants that are associated with cognitive ability."

Yet the study's authors estimate that the 74 genetic markers they uncovered comprise just 0.43% of the total genetic contribution to educational achievement (A. Okbay *et al.* *Nature* <http://dx.doi.org/10.1038/nature17671>; 2016). By themselves, the markers cannot



Genetic differences explain just 3.2% of the variation in educational achievement between people.

predict a person's performance at school. And because the work examined only people of European ancestry, it is unclear whether the results apply to those with roots in other regions, such as Africa or Asia.

The findings have proved divisive. Some researchers hope that the work will aid studies of biology, medicine and social policy, but others say that the emphasis on genetics obscures factors that have a much larger impact on individual attainment, such as health, parenting and quality of schooling.

"Policymakers and funders should pull the plug on this sort of work," said anthropologist Anne Buchanan and genetic anthropologist Kenneth Weiss at Pennsylvania State University in University Park in a statement to *Nature*. "We gain little that is useful in our understanding of this sort of trait by a massively large genetic approach in normal individuals."

The study is the latest to apply genetic

TIM SMITH/PANOS

analysis to social science. Some of its authors have also studied the genetics of happiness, and plan to examine the genetics of fertility and of risk-taking behaviour.

“There’s been a long-standing assumption that [genetic] differences among people are not really relevant for social-science studies,” says study co-author Christopher Chabris, a cognitive psychologist at Union College in Schenectady, New York. “The main effect of this work may be the increasing realization that genetic differences matter, and now people can start to figure out how and why.”

Robert Plomin, a behavioural geneticist at King’s College London, agrees. The study’s authors identified 9 million genetic variants that, as a group, have some influence on school success; these include the 74 genetic markers that show strong individual influence. Considered as part of an overall ‘polygenic’ score, the variants explain 3.2% of the differences in educational attainment between individuals. Plomin says that such studies could pave the way to predictive genetics for traits such as how well children perform on standardized tests.

Still, the researchers estimate that a person who carries two copies of the genetic variant that has the strongest known effect would complete nine more weeks of schooling over a lifetime than a person with no copies.

The authors also report that the markers they found overlap with those associated with better performance in cognitive tests, bolstering the idea that educational attainment is a proxy for intelligence. Because few large studies have tested individuals’ cognitive performance, it has been difficult to discern genetic factors linked to intelligence. But it is much easier to amass large amounts of data that have sufficient statistical power to uncover genetic effects related to educational attainment, because medical studies routinely record data on participants’ years of schooling.

Hsu predicts that growing knowledge of genetic contributions to intelligence could be used to help parents to select embryos created through *in vitro* fertilization. “You could allow the parents to decide whether they want to implant or not implant an embryo that has a serious cognitive impairment,” Hsu says. “What is missing is the ability to know what places in the genome are affecting cognitive ability, but studies like this one will get us to that point.”

But even if all the genetic contributors to educational attainment were known, the study’s authors say, their effect would probably be overshadowed by other factors such as the socio-economic and educational status of a child’s family. Says Chabris, “It would be irresponsible to look at a polygenic score and use it to make a prediction for a single individual.” ■



The tattoos include two seated baboons depicted around a wadjet eye (top row), a symbol of protection.

#### ARCHAEOLOGY

# Sacred tattoos found on Egyptian mummy

*Unusual designs include eyes, flowers and animals.*

BY TRACI WATSON

A mummy from ancient Egypt was heavily tattooed with sacred symbols, which may have served to advertise and enhance the religious powers of the woman who received them more than 3,000 years ago.

The tattoos are the first found on a mummy from dynastic Egypt to show actual objects, among them lotus blossoms on the mummy’s hips, cows on her arm and baboons on her neck. Just a few other ancient Egyptian mummies sport tattoos, and those are merely patterns of dots or dashes.

Especially prominent among the mummy’s tattoos are ‘wadjet eyes’: possible symbols of protection against evil that adorn the mummy’s neck, shoulders and back. “Any angle that you look at this woman, you see a pair of divine eyes looking back at you,” says bioarchaeologist Anne Austin of Stanford University in California, who presented the findings last month at a meeting of the American Association of Physical Anthropologists in Atlanta, Georgia.

Austin noticed the tattoos while examining mummies for the French Institute of Oriental Archaeology in Cairo, which conducts research at Deir el-Medina, a village once home to the ancient artisans who worked on tombs in the nearby Valley of the Kings. Looking at a headless, armless torso dating from 1300 BC to 1070 BC, Austin noticed markings on the neck. She soon realized that they were tattoos.

Austin knew of tattoos discovered on other mummies using infrared imaging (M. Samadelli *et al.* *J. Cult. Herit.* **16**, 753–758; 2015), which peers more deeply into the skin than visible-light imaging. With help from infrared lighting and an infrared sensor, she determined that the Deir el-Medina mummy boasts more than 30 tattoos, including some on skin so darkened by the resins used in mummification that they were invisible to the eye. Austin and Cédric Gobeil, director of the French project at Deir el-Medina, digitally stretched the images to counter distortion from the mummy’s shrunken skin.

The tattoos identified so far carry powerful religious significance. Many, such as the cows, are associated with the goddess Hathor, one of the most prominent deities in ancient Egypt. The symbols on the throat and arms may have been intended to give the woman a jolt of magical power as she sang or played music during rituals for Hathor.

The tattoos may also be a public expression of the woman’s piety, says Emily Teeter, an Egyptologist at the University of Chicago’s Oriental Institute in Illinois. “We didn’t know about this sort of expression before,” Teeter says, adding that she and other Egyptologists were “dumbfounded” when they heard of the finding.

Austin has already discovered three more tattooed mummies at Deir el-Medina, and hopes that modern techniques will uncover more elsewhere. ■