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## Your brain may soon be used against you

By Faye Flam, Inquirer Staff Writer

**T**he last refuge of secrets and lies - the brain - may be about to reveal all.

Scientists are finding ways to use the brain's activity to expose truths a person may try to hide. The techniques could revolutionize police work, improve national security, and threaten personal privacy.

"It's the scariest thing around," said physicist Robert Park, an outspoken critic of old-fashioned, unreliable polygraph machines. "The only thing worse than a lie detector that doesn't work is one that does."

Ruben Gur, a neuropsychologist at the University of Pennsylvania, says new kinds of brain scans can reveal when a person recognizes a familiar face, no matter how hard he or she tries to conceal it.

The scanning machine, called a functional MRI, takes pictures that highlight specific parts of the brain activated during certain tasks. Telltale parts of your brain "light up," he said, when you are presented with a face you have seen before.

It is easy to imagine such scanners being used in interrogation of criminal suspects or terrorists about their associates. Gur described just such possibilities for national security experts at a recent Penn workshop.

"Everything we do, and everything an enemy does, starts in the brain," he said at the Penn meeting, sponsored by the newly formed Institute for Strategic Threat Analysis and Response, which includes Penn epidemiologists, germ-warfare specialists, political scientists, and computer experts.

Such scanning could also be used to pick up brain abnormalities that he says characterize those prone to violence.

Another Penn scientist, Daniel Langleben, has found that a functional MRI can act as a lie detector. A handful of other scientists around the country are examining ways to read thoughts by examining the brain.

"In the long term, I think we will have technologies powerful enough to understand what people are thinking in ways unimaginable now," Langleben said. "I think in 50 years we will have a way to essentially read minds."

He said he was not particularly happy about that. Neither are others concerned about the unprecedented threat to humanity's most private realm.

Gur acknowledges the concerns about brain scans eventually revealing private thoughts. The balance between security and privacy is something society will have to come to grips with in many areas, he said.

### **A long quest**

To Gur and Langleben, visions of Orwellian thought police do not overshadow the potential benefits and the ever-tantalizing scientific prospect of understanding how the mind works.

Gur said this work grew out of a long-standing quest to understand the nature of conscious thought. When he set out to study consciousness, in the 1970s, the concept was so hazy as to be out of the realm of scientific inquiry.

With the advent of imaging machines such as MRIs, scientists found the machines were capable of witnessing the brain in action by tracing the way blood flowed to specific regions during various mental tasks. Gur got in early, testing which of the many small structures inside the brain were activated when test subjects were resting, reading words, recognizing shapes, or trying to remember facts.

The early machines used radioactive tracers that would "light up" regions where metabolism was fastest. He went on a long diversion exploring differences between the way men and women used their brains. He found, among other things, that differences in the brain endowed women with better memories and better control of emotions, while men were more likely to be hot-headed.

In the last several years, he started focusing on the way the brain responds to emotion. Through a friend at the Arden Theatre Company, he brought together 140 Philadelphia-area actors.

### **Signs of recognition**

He asked them to portray a range of emotions - happiness, sadness, fear, anger and disgust. He took pictures of the actors and showed them to volunteers whose brains were being scanned by a functional MRI, which works by monitoring the way molecules in the brain tissue respond to a magnetic field.

He isolated a number of centers in the brain that were activated when the volunteers looked at the emotional faces. Then he decided to show the volunteers faces they had seen before mixed in with new faces, to see if their brains registered recognition.

The familiar faces stimulated more activity than the new ones in several areas, including the hippocampus, which regulates memory, and parts of the visual cortex. He published his findings in the May issue of the journal *NeuroImaging*.

Investigators have long employed numerous methods to detect lies - voice analysis, observations of body language and facial expressions, and the polygraph, which measures changes in skin conductance and pulse rate. Controversial since its invention, the polygraph fell further out of favor this month when the National Academy of Sciences deemed it too inaccurate for the government to use to screen people as potential security risks.

"The polygraph only catches people who are anxious about lying," often letting through those who lie with ease, Gur said.

Langleben said he was inspired by studying children with attention deficit disorder. He noticed that such children often had trouble telling fibs - they would just blurt out whatever came into their minds first, which was usually the truth. That led him to wonder whether the part of the brain that helps control behavior also helped people to lie.

He found himself collaborating with Gur, who shared his interest.

They started with a standard test - called the "guilty knowledge test," used in polygraph studies. Volunteers were asked to choose a playing card and put it in an envelope along with a \$20 bill. The subjects were hooked up to the scanner and asked a series of yes or no questions about the identity of the card. They were told they would get the \$20 if they could fool the computer.

When the subjects lied, the scanner showed increased activity in several areas, including one called the anterior cingulate region, which Gur said was activated by conflicting information or errors. Also activated more in lying was a part of the frontal cortex normally involved in making decisions. Finally, the researchers also saw more activity in the part of the brain that controls the right hand - since volunteers had to communicate their answer by pushing buttons.

The scientists still cannot tell when each individual is lying - they only get significant results when they average results from many subjects. But they say they are getting closer to the ultimate goal of lie-detecting: being able to tell individual truths from lies - and truth-tellers from liars.