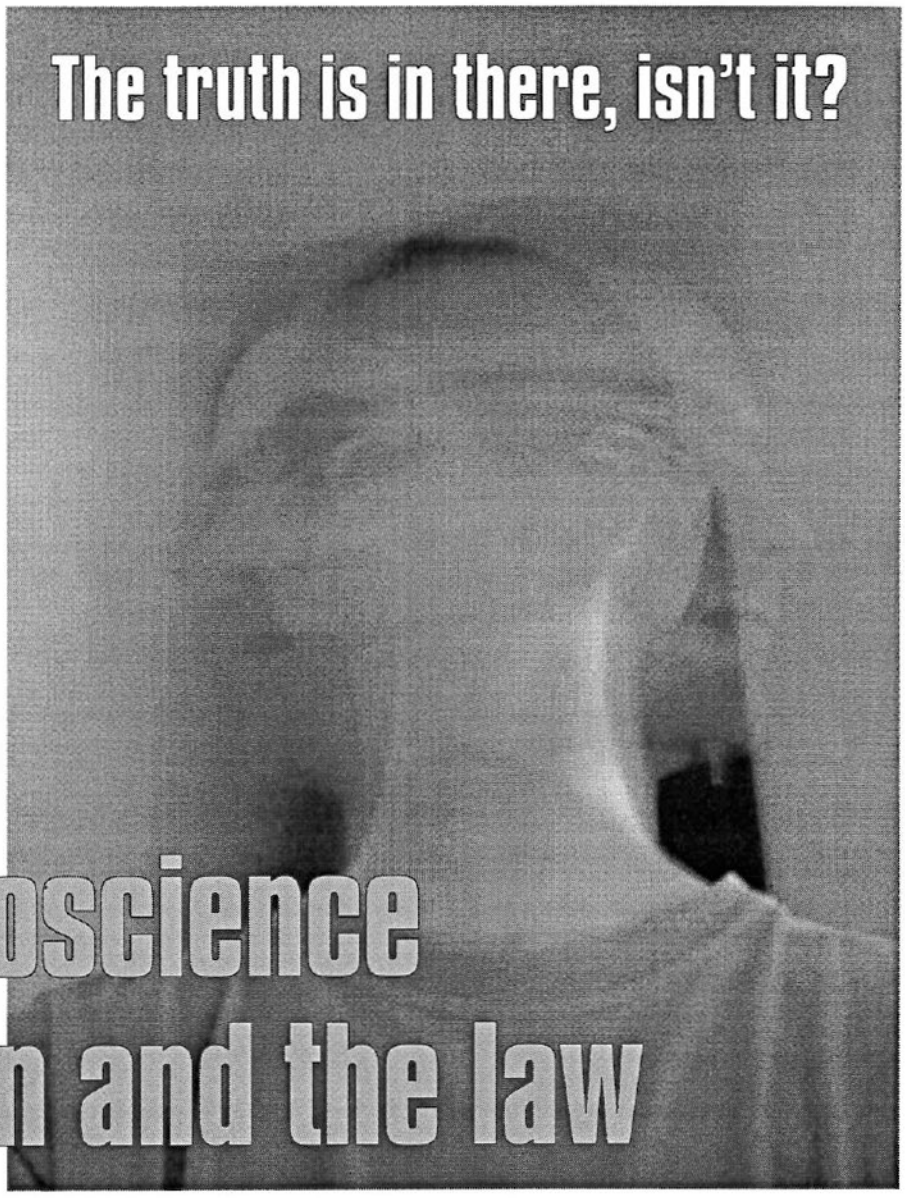

The truth is in there, isn't it?

A revolution under way in neuroscience has potentially significant legal implications, including the possible use of new technology to distinguish true from false recollections. Andrew Lyons looks at the advances that may one day do more than replace the lie detector.

The neuroscience revolution and the law

Attempts to use technology to test whether a person is telling the truth are not new. The polygraph has been in use since 1924, but new technology has brought a revolution in neuroscience that offers the prospect of more sophisticated lie detectors.

This article looks at the technological advance, the research that utilises it, and the implications for the law.

Technological advance

The existing technology, that is, the polygraph relies upon observations of physiological functions (for example, heart rate, blood pressure, respiration, electrical conductance at skin level) that might betray the mental state of the subject.

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Polygraphs are unreliable but not completely useless. A unit of the US National Academies[1] has concluded that polygraphs are "intrinsically susceptible to producing erroneous results" because, amongst other things, the responses measured by a polygraph are affected by many psychological and physiological factors (for example, anxiety about being tested) other than truthfulness.[2]

It also concluded that "all the physiological indicators measured by the polygraph can be altered by conscious efforts through cognitive or physical means".[3]

On the positive side, it concluded that "in populations of examiners [using a polygraph] such as those represented in the polygraph research literature, untrained in countermeasures [that might be employed by an examinee], specific-incident polygraph tests can discriminate lying from truth telling at rates well above chance, though well below perfection".[4] A specific incident test is just what the name suggests, a test about a specific incident, for example, did you see the victim on Monday?

The technological development is the advance in brain imaging technology. The *structure* of the brain can be studied by computer-assisted tomography (CAT) scans and magnetic resonance imaging (MRI). The *function* of different parts of the brain can be studied by positron emission tomography (PET) scans, single photon emission tomography (SPET) scans and functional magnetic resonance imaging (fMRI).[5]

Brain imaging technology is revolutionary because, unlike the polygraph, it permits direct observation of brain activity as opposed to observations of the subject's peripheral responses.

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Following are three illustrations of research utilising brain imaging technology.

Research

First, fMRI technology has been used by a Harvard University team to find that many regions of the brain respond differently according to whether or not the subject's claim to have recognised something was true or false.[6]

Participants in the experiment were asked to study cards and were then tested by being shown some of those cards mixed with others. fMRI analysis was undertaken of brain activity during the test phase.

When participants correctly recognised a shape as one shown to them in the study session, regions of the brain used for early visual processing were more active. During incorrect recognition, pre-frontal, parietal and the left temporal cortex regions, amongst others, were more active. Some regions were associated with both false and true recognitions.

Secondly, fMRI technology has also been used by a University of Pennsylvania team which concluded that further refinement of the design and image analysis methodology would permit identification of a brain activation pattern predictive of deception by an individual.[7]

Participants in this study tried to deceive the computer as to whether or not they had a particular playing card. Unlike the Harvard study mentioned above, this test required the participants to give deliberately false answers.

The study found that, when a participant lied, brain activity in several regions of the brain increased.

Thirdly, in the early 1990s the CIA funded research at the University of Illinois by Emanuel Donchin and Lawrence Farwell, which focused on a peak in EEG measurements named the P300.[8]

Dr Farwell claims that a P300 peak is an automatic and immediate response to a true recognition of a fact. He uses this to test for guilty knowledge: The investigator refrains from publicly disclosing particular facts about a crime scene that are known only to investigators and those there at the time of the crime. Suspects with knowledge of the 'guilty' fact generate the P300 response; those with no knowledge of it do not do so.

This technology was used to provide evidence that was received by a trial court in Iowa.[9] However, the claims made by Dr Farwell about this methodology have been the subject of heavy attack by Professor Donchin. First, the stimulus used in the guilty knowledge test is chosen by the investigator. Thus, it is a subjective choice. Secondly, Professor Donchin says that the P300 response can occur because something is infrequent as well as meaningful.

More recently, Dr Farwell has used multifaceted electroencephalographic response analysis (MERA) technology which, like the technology used in his previous research, analyses specific, short-term segments of brain wave data elicited by information-processing brain activity. It is an improvement on the prior technology because it simultaneously examines multiple facets of the data.

Using this technology, Dr Farwell and his colleagues say that they have found a specific response that is elicited when a person recognises and processes a stimulus that is particularly noteworthy to him or her. Use of the technology to determine whether or not information was present in the subject's brain led to an outcome with no false negatives, no false positives and no indeterminate outcome.

Dr Farwell's research is widely published but much of it is not in peer-reviewed journals. While the article reporting the above research was published in a peer-reviewed journal, it is one on forensic sciences, rather than a specialist neuroscience journal. He operates a commercial service marketing his technology.

The research reviewed above is, as stated, but part of the revolution in neuroscience. Brain imaging technology is being used to research other aspects of human behaviour which have important legal implications.

For example, in the past five years it has been used to analyse the brain processes in moral reasoning, social cooperation, violent behaviours, responses to race groups and love.

Conclusions

This research has obvious, major potential implications for the fact-finding process. It suggests that it may be possible to design a machine that will, by non-invasive observation and measurement of brain activity, discern whether a claimed recollection is true or false, even if the claimant is intending to deceive.

Nevertheless, while the pace of technological advance has been fast, there is still a lot to be done before falsehood detection technology is ready for use in the courts. The National Academies' report, 'The polygraph and lie detection', cited above concludes that:

"Techniques based on measurement of brain activity through electrical and imaging studies have good potential on grounds of basic theory. However, research is at a very early stage with the most promising techniques, and many methodological, theoretical, and practical problems would have to be solved for these techniques to yield improvements on the polygraph . . .

"Not enough is known, however, to tell whether it will ever be possible in practice to identify deception in real time through brain measurement. We are confident that it will not happen within the next decade. Moreover, brain-based indicators will not necessarily be resistant to countermeasures."

The potential for the revolution in neuroscience to have far-reaching effects on the legal system, especially fact finding, is readily apparent. Fact finding is an Achilles' heel of the legal system so such research is to be encouraged. If the truth is in there, there may be new ways of finding it.

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Notes

1 Peak body of the Academies of Science and Engineering, the National Institute of Medicine and the National Research Council.

2 Committee to Review the Scientific Evidence on the Polygraph, (US) National Research Council, The Polygraph and lie detection, US National Academies, 2003, p2, viewed at http://books.nap.edu/execsumm_pdf/10420.pdf on December 1, 2004.

3 Committee to Review the Scientific Evidence on the Polygraph,(US) National Research Council, n 2 at 4.

4 Committee to Review the Scientific Evidence on the Polygraph, (US) National Research Council, n 2 at 214, http://books.nap.edu/books/0309084369/html/212.html#pagetop viewed December 1, 2004.

5 Greely HT, Neuroethics: The Neuroscience Revolution, Ethics, and the Law (Regan Lecture delivered April 20, 2004, for Markkula Center for Applied Ethics), http://www.scu.edu/ethics/publications/submitted/greely/neuroscience_ethics_law.html viewed December 1, 2004.

6 Slotnick SD and Schachter DL, A sensory signature that distinguishes true from false memories, Nature Neuroscience, Vol 7, Number 6, June 2004, 664, http://www.wjh.harvard.edu/~slotnick/articles/slotnick04_nat_neurosci.pdf viewed December 1, 2004.

7 Langleben DD, Schroeder JA, Maldjian JA, Gur RC, McDonald S, Ragland JD, O'Brien CP and Childress AR, Brain Activity during Simulated Deception: An Event-Related Functional Magnetic Resonance Study, (2002) 15 NeuroImage 727, http://www.uphs.upenn.edu/trc/conditioning/neuroimage15_2002.pdf viewed December 2, 2004.

8 Farwell LA, Donchin E, 'The Brain Detector: P300 in the detection of deception', Psychophysiology, 1986, 24, 434 and Farwell LA, Donchin E, 'The truth will out: interrogative polygraphy (lie detection) with event-related brain potentials', Psychophysiology, 1991, 28, 531.

9 *State of Iowa v Harrington*, O'Grady J, unreported, No. 01-653, Pottawattamie County, No. PC073247, March 5, 2001. The appeal is *Harrington v State of Iowa* (2003) 659 N.W.2d 509.