IN THE NEWS

Face facts

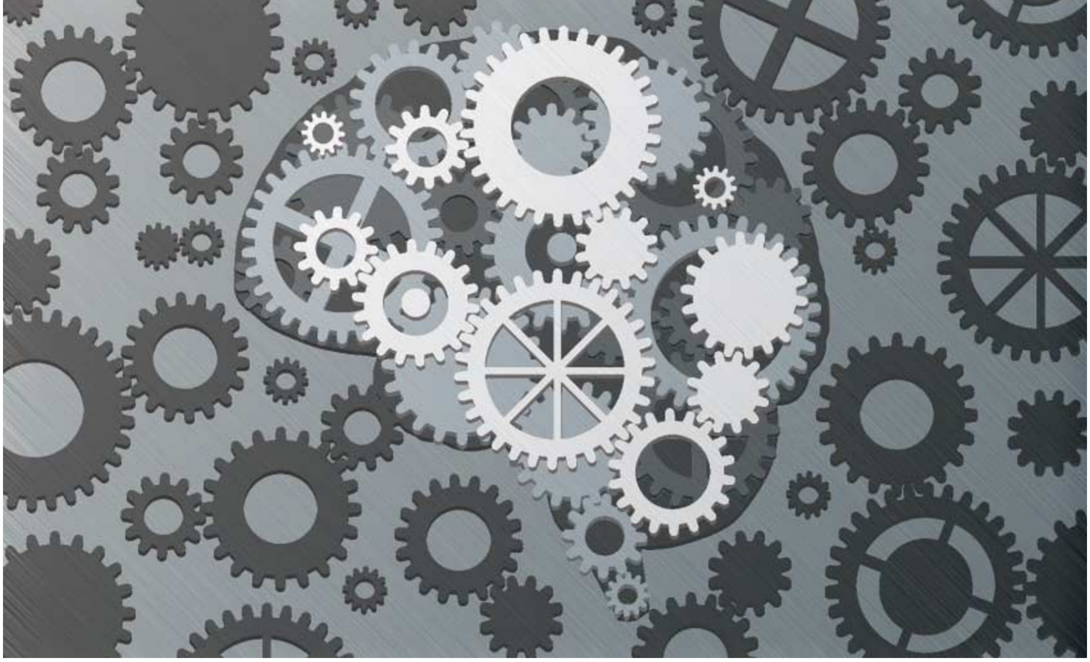
What do you get if you cross Margaret Thatcher with Marilyn Monroe? A scary prospect, you might think, but, as a recent report in *Nature Neuroscience* shows, this bizarre-sounding approach provides fascinating insights into how the brain recognizes faces.

Pia Rotshtein and co-workers at University College London morphed images of famous faces into those of different celebrities — for example, Maggie to Marilyn and Tony Blair to Pierce Brosnan. Volunteers were shown images from various points along the morph continuum, and brain activity was measured as they tried to put a name to the face.

Three brain areas were activated during recognition: "the inferior occipital gyri…picked up on small physical changes in the morphed faces. The right fusiform gyrus…forced the face into a known or unknown category. The anterior temporal cortex…is believed to store facts about people we know, and was more active when volunteers were very familiar with the face" (*Scotsman*, UK, 13 December). Damage to these areas is associated with impaired face recognition: "dementia patients with damage to the anterior temporal cortex have a problem finding the name to go with the face, while people with epilepsy triggered by the right fusiform gyrus sometimes believe that different faces belong to the same person" (*Guardian*, UK, 13 December).

Rotshtein adds "the brain tries to force us to pin a single identity on a face, even if it looks like a mix of two people we know" (*Scotsman*). So "a face 60 per cent Marilyn and 40 per cent Margaret Thatcher will be identified as an older Marilyn, while an image 40 per cent Monroe and 60 per cent Thatcher will be seen as the sexier side of Margaret" (*Daily Mirror*, UK, 13 December).

Heather Wood



ELECTROENCEPHALOGRAPHY

Mind control

The development of practical brain–computer interfaces (BCIs) that could allow disabled people to communicate or control prostheses has taken another step forward, with the demonstration that non-invasive electroencephalogram (EEG) signals can be used for multidimensional control of a cursor on a screen.

The idea behind BCIs is to use a computer to 'read' electrical signals from the brain and to translate these into movements — of a cursor, a robotic arm or some other device. The electrical signals can be recorded either from within the brain or from the cortical or scalp surface. Until now, it has been thought that invasive recordings from within the brain would be necessary for the control of complex motions, although EEG recordings have been shown to be sufficient for controlling one-dimensional movements of a cursor. Monkeys can use invasive BCIs to control multidimensional movement, but because implanted electrodes carry with them a risk of infection or damage this solution is not ideal for use in humans.

Now, though, Wolpaw and McFarland have shown that humans can use scalp-recorded EEGs to control two-dimensional movements of a cursor with an accuracy and speed that are similar to those achieved by monkeys using invasive BCIs. They tested their system on four subjects, two of whom were paralysed as a result of spinal cord injury and two of whom had normal motor function. The subjects' EEGs were recorded through 64 electrodes on the scalp and a small subset of the recorded channels was used to control the movement of a cursor in two dimensions — horizontal and vertical.

Previous attempts to use scalp EEGs for this type of control have been much less successful. However, two key factors account for the success of the new study. First, the authors used advances in signal processing to increase the correlation between the subjects' intentions and the EEG features that were used to represent them. Second, they developed an adaptive algorithm that focuses on the EEG features that the subjects can control most effectively and encourages further improvements in that control. As a result, the subjects' ability to control the cursor in both dimensions improved gradually over training trials and they were eventually able to make rapid and accurate movements of the cursor towards targets on the screen. Interestingly, the two paralysed subjects achieved better control of the cursor than the two able-bodied subjects, which the authors suggest might reflect increased motivation or sensorimotor plasticity subsequent to their spinal cord injuries.

When the authors compared the results of this study with the findings of studies that used invasive BCIs in monkeys, they found that both movement times and accuracy were similar, indicating that invasive BCIs do not necessarily provide better control than scalp-recorded EEGs. This is encouraging for the application of BCIs in humans who are disabled as a result of spinal cord injury, neuromuscular disease or stroke, as non-invasive electrodes would be safer and better tolerated than implanted electrodes. However, the authors suggest that the best results might be obtained by a compromise — EEG signals recorded from the cortical surface, rather than the scalp. Such recordings would be only minimally invasive but might yield great advances in motor control when combined with appropriate signal processing techniques and algorithms.

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References and links

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FURTHER READING Nicolelis, M. A. L. Brain–machine interfaces to restore motor function and probe neural circuits. *Nature Rev. Neurosci.* **4**, 417–422 (2003) | Wolpaw, J. R. *et al.* Brain–computer interfaces for communication and control. *Clin. Neurophysiol.* **113**, 767–791 (2002)