IN THE NEWS

Genespeak

"British scientists have pinpointed a single genetic defect that causes a rare hereditary language disorder, providing the strongest evidence yet that mankind's sophisticated communication skills are determined by DNA".

This is how *The Times* (UK, 4 October) heralded the news that Tony Monaco's team at the University of Oxford have shown that a mutation in the forkhead-domain gene *FOXP2* is responsible for an inherited speech disorder that was first identified in a British family. Affected individuals find it difficult to form words and have problems with certain aspects of grammar, such as changing the tense of verbs.

The heritable nature of this disorder seems to support the idea, proposed by Noam Chomsky in the 1950s, that the ability to learn language is innate in humans. Even Charles Darwin was on the case (*The Times*, 4 October); in *The Origin of Species* he states: "Man has an instinctive tendency to speak, as we see in the babble of our young children, while no child has an instinctive tendency to bake, brew or write".

However, some scientists are sceptical about the idea that linguistic ability resides in specific brain structures or genes. In a letter to the *New York Times* (5 October), cognitive scientist Philip Lieberman suggests that the *FOXP2* mutation affects the basal ganglia nonspecifically, like Parkinson's disease, which also causes "deficits in both manual and speech motor control, and in comprehending grammar and abstract reasoning". Language researcher Bruce Tomblin points out that "several variant genes that seemed at first to affect only speech [have] turned out to cause other cognitive problems as well" (*New York Times*, 4 October). Clearly, this new study has not been able to resolve the debate over whether there are genes 'for' language.

Heather Wood

NEUROIMAGING

Snap!

The Wisconsin card sorting test is a popular choice among neuropsychologists studying the function of the prefrontal cortex. Part of its beauty is its simplicity. The subject sits opposite the experimenter, and is shown cards one at a time. On each card are between one and four symbols (triangles, stars, crosses or circles) in one of four colours (red, green, yellow or blue). So each card could be classified by the number, colour or type of symbol.

The subject has to say with which of four test cards — between them representing all of the symbols, colours and numbers — each new card should be paired. The experimenter doesn't say which rule is in place, but simply tells the subject whether each decision is right or wrong, allowing them to work out whether they are supposed to classify cards by number, colour or symbol. At some point during the session, the rule will change without warning, and the subject will have to stop using the old rule and figure out what the new rule is.

Patients with damage to the prefrontal cortex find this task much harder than control subjects do. They tend to perseverate — they will continue to classify cards by the original rule, even though they are repeatedly told that it is wrong — or make other types of mistake. Patients with Parkinson's disease are also impaired on the test, a fact that implicates the basal ganglia in card sorting. Previous functional imaging studies have confirmed that parts of the prefrontal cortex are activated during the Wisconsin card sorting test, but activity in the basal ganglia has been less clear. Now Monchi *et al.* have used event-related functional magnetic resonance imaging to give a much clearer and more detailed picture of brain activity during the different phases of the test.

Their results confirm that parts of the prefrontal cortex are specifically activated during testing. They also show activity in parts of the basal ganglia — the caudate nucleus and putamen. More interestingly, the authors were able to identify different patterns of activity during different stages of the test. For example, the mid-dorsolateral prefrontal cortex, which is thought to be important for monitoring information in working memory, was active when subjects were told whether their decision was right or wrong. However, the mid-ventrolateral cortex, along with the caudate nucleus and mediodorsal thalamus, was active only when the subjects received negative feedback, signalling the need to change strategy. These structures form an anatomical loop that is thought to be crucial for cognitive functions, such as those required to change from one rule to another.

Other parts of the brain were more active at the response stage, rather than during feedback. These included the putamen, which is more important for motor function, consistent with the fact that subjects had to carry out an action during this phase. But the putamen was active only when this phase followed negative feedback. The putamen and the posterior lateral prefrontal cortex, which was also active during this period, are connected through another loop. These findings indicate that this loop might be more involved in novel actions (or in performing an action according to a new behavioural rule).

These results could shed new light on the different deficits in the Wisconsin card sorting test that follow different types of injury or disease. Even this apparently simple task, it seems, has more to it than meets the eye.

Rachel Jones

References and links

ORIGINAL RESEARCH PAPER Monchi, O. *et al.* Wisconsin card sorting revisited: distinct neural circuits participating in different stages of the task identified by event-related functional magnetic resonance imaging. *J. Neurosci.* **21**, 7733–7741 (2001)

FURTHER READING Miller, E. K. The prefrontal cortex and cognitive control. *Nature Rev. Neurosci.* **1**, 59–65 (2000)