

▶ This study, conducted by Reinout Wiers of the University of Amsterdam and his colleagues, attempted to correct the approach bias to alcohol with CBM. The 214 participants received either a standard addiction treatment—a form of talk therapy—or the standard treatment plus four 15-minute sessions of CBM. In the first group, 41% of participants were abstinent a year later; in the second, 54%. That is not a cure for alcoholism, but it is a significant improvement on talk therapy alone.

Many other researchers are now exploring CBM. A team at Harvard, led by Richard McNally, is seeking volunteers for a month-long programme that will use smart-phones to assess the technique's effect on anxiety. And Dr Bar-Haim and his team are examining possible connections between cognitive biases and post-traumatic-stress disorder in the American and Israeli armies.

Not all disorders are amenable to CBM. One study, by Hannah Reese (also at Har-

vard) and her colleagues, showed that it is ineffective in countering arachnophobia (perhaps not surprising, since this may be an evolved response, rather than an acquired one). Moreover, Dr Wiers found that the approach bias towards alcohol is present in only about half of the drinkers he studies. He hypothesises that for the others, drinking is less about automatic impulses and more about making a conscious decision. In such cases CBM is unlikely to work.

Colin MacLeod of the University of Western Australia, one of the pioneers of the technique, thinks CBM is not quite ready for general use. He would like to see it go through some large, long-term, randomised clinical trials of the sort that would be needed if it were a drug, rather than a behavioural therapy. Nevertheless, CBM does look extremely promising, if only because it offers a way out for those whose answer to the question, "Do you want to talk about it?" is a resounding "No". ■

into believing that it is another human being. But the Turing test still requires the program to share a language with the tester and, because it is all or nothing, cannot be used to rank different forms of artificial intelligence against one another.

José Hernández-Orallo of the Polytechnic University of Valencia, in Spain, and David Dowe of Monash University, in Australia, think they can do better than this. They believe not only that a universal scale of intelligence can be devised, but also that it can be assessed without reference to language. If they are right, an insult like "bird-brained" will, in the future, be finely calibrated.

Dr Hernández-Orallo and Dr Dowe, both computer scientists, propose to make their measurement by borrowing a concept called Kolmogorov complexity from information theory, a branch of computer science. The Kolmogorov complexity of a computer's output is the shortest possible program (measured in the binary digits that lie at the bottom of all computer code) that could produce that output. On this measure, an entity's intelligence would be measured by the Kolmogorov complexity of the most complex tests it can solve—a clear, numerical value. In practice, calculating the true Kolmogorov complexity of a system is almost impossible. But an approximation can be made. And that, the researchers reckon, will be good enough.

The actual tests would employ the well-honed methods of operant conditioning, developed initially on pigeons, in which the test subject has first to work out what is going on by trial and error. As in operant conditioning, correct responses would be rewarded—by money, perhaps, for a human being; by bananas for a chimpanzee or by the numerical value itself for an appropriately programmed computer.

If the test were noughts and crosses, the test-taker (if it had never seen the game before) would first have to work out that the game is won by getting three in a row on a 3-by-3 grid, before actually going on to play. A chimpanzee might not manage a test of this level of complexity, but could, maybe, work out the idea of three-in-a-row when only a single row was involved. Chess, though, would surely be beyond it (and probably beyond most people, too, if they did not already know the rules). Games like draughts and dominoes would lie somewhere in between.

In fact Dr Hernández-Orallo and Dr Dowe do not plan to use existing games. Instead they are employing a computer to generate novel games and patterns. Their approach eliminates human bias. It also allows them to generate tests with any level of complexity they like—even ones that are far beyond the ability of humans to complete. When it comes to testing the tests, then, aliens from the planet Zaarg will be particularly welcome to apply. ■



Intelligence testing

Who are you calling bird-brained?

An attempt is being made to devise a universal intelligence test

WHAT is the IQ of a chimpanzee? Or a worm? Or a game-show-winning computer program? Or even an alien from the planet Zaarg who can learn any human language in a day, can beat chess grandmasters ten at a time and can instantly factor the products of large prime numbers? At the moment it is impossible to say. IQ tests depend on language, and even Watson, a computer program that beat two human contestants in a special edition of

"Jeopardy!" (an American quiz show) on February 16th, does not have a perfect command of English. In any case there is, at the moment, no meaningful scale on which non-human intelligence can be compared with the human sort.

The most famous test for artificial intelligence is that devised by Alan Turing, a British computing pioneer. To pass the Turing test, and thus be considered intelligent, a program must fool a human being