How you can boost your brain power

Training is the only way to improve sporting prowess but a new study reports that mental training can increase your intelligence quotient (IQ) score. And the harder you train, the more you can gain.

So-called "fluid intelligence", or Gf, is the ability to reason, solve new problems and think in abstract. It is linked to professional and educational success and appears to be largely genetic. A straightforward mental agility exercise reported in *New Scientist* has been found to increase Gf IQ scores. The first part of the exercise involves small squares on a screen that pop into a new location every three seconds. Volunteers have to press a button when the location is a duplicate of two earlier "views". The second part is similar, but involves letters read out through headphones. If participants perform well, the interval to be tracked increases to three or more stages earlier. Daily training for 20 minutes increased IQ scores, and those who did more training made greater improvements.

If regular mental agility training sounds too much like hard work, other methods have been suggested to boost brain power. Smart drugs like modafinil are known to boost concentration but are not yet licensed for improving examination scores. This narcolepsy treatment can keep you awake and alert for 90 hours without any of the jitteriness or bad concentration associated with caffeine or amphetamines. It is unlikely ever to become a legitimate method of IQ improvement, however. Dietary changes will not cause such dramatic results but, after all, you are what you eat. So healthy "brain food" is worth a try. Regular breakfasting aids concentration, antioxidants help mop up dangerous free radicals, and omega-3 fatty acids, particularly docosahexaenoic acid, may help stave off dementia.

Listening to Mozart has been shown to improve mathematical and spatial reasoning. And you do not have to be a music lover to benefit, as even rats run mazes faster and more accurately after hearing the great composer's music. It has been suggested, however, that these results are caused simply by participants feeling relaxed and stimulated at the same time and a comparable stimulus might do just as well.

But simple things make a big difference too. The right amount of rest and exercise are vital for peak performance. Planning, problem solving, learning, concentration, working memory and alertness all suffer after a lack of sleep. A person who has remained awake for 21 hours has the mental abilities of someone intoxicated by alcohol. Schoolchildren who exercise three or four times a week get higher than average examination grades at age 10 or 11. It all goes to show that a healthy mind really is a by-product of a healthy body.

Logarithms – nature or nurture?

Scottish mathematician John Napier first "discovered" logarithms in 1614, but a recent study published in *Nature* suggests this counting scheme could be innate in all humans.

Teenage mathematics students would argue that using logarithm tables is anything but instinctive, but researchers have found an Amazonian tribe that judges magnitudes on a logarithmic basis despite a lack of exposure to the linear counting scale of the industrialised world. Members of the Mundurucu tribe were asked to locate on a line the points that best signified the number of various stimuli (dots, sequences of tones or spoken words) in the ranges from one to 10 and from 10 to 100. They clearly apportioned the divisions logarithmically, which means that successive numbers get progressively closer together as they get bigger.

The researchers argue that our linear scaling, in which the distance between each number is the same, irrespective of their magnitude, is a cultural invention. And numerous examples of logarithms in nature and in our intuitive thinking support that argument. The phenomenon of life speeding up as we get older is an example familiar to us all, as each passing year becomes a smaller proportion of our whole life.

The magnitudes occurring in nature take on most meaning when expressed logarithmically. The fentometre (10^{-15}m) is the scale of the atomic nucleus, the nanometre (10^{-9}m) that of molecular systems, and the micrometre (10^{-6}m) the scale of the living cell.

The immense variation in the size of earthquakes is measured using the logarithmic magnitude scale, while the same is true of the decibel scale for sound intensity and the pH scale. Younger pharmacists may still remember the log scales used in pharmacokinetics graphs explaining how the body distributes and metabolises drugs.

But logarithms were not Napier's only claim to fame. He was also the first to use the decimal point and he proposed the first mechanical means of calculation, making him the grandfather of modern day calculators.

Untangling spiders' silky secrets

Spider webs are truly a marvel of nature. Their construction uses techniques and materials that our greatest engineering minds have never matched — until now.

Researchers from Germany have built a microfluidics system (a type of miniature plumbing set-up) for spinning short strands of artificial spider silk. They are still some way away from making a spider's web though, because the strands are less than half a millimetre long and their strength and elasticity remains untested.

Other researchers have created longer strands that come close to the properties of spider silk, designed for weaving into lighter bullet-proof vests or artificial tendons and ligaments. But even short strands may have a place in medical procedures such as brain surgery.

The German researchers studied artificial dragline silk, which spiders use to hang from ceilings and to outline their webs. The researchers based their silk on that of *Araneus diadematus*, the European garden spider. Genuine dragline silk can hold over 280 million kg/m^2 without breaking, making it stronger than steel in weight for weight terms.

It is difficult to farm spiders for their silk, because of their propensity for eating each other, so the team inserted a pair of dragline silk genes into bacteria to produce their raw material. They managed to eject the resultant fluid, in a spider-like manner, through a constriction measuring roughly 10µm wide at a speed of 600µL per hour (equivalent to a flow rate of less than 10 fl oz per minute through a garden hose).

There is still some way to go before matching some of the spider world's best spinners, which can produce up to 2,000ft of silk continuously.

While still in the spider's gland the secretion is a water soluble viscous fluid. But upon being drawn through spinnerets, its molecular arrangement changes and it becomes insoluble and 10 times more dense than in the fluid state.