The Connell Multiple Intelligence Questionnaire for Children

Place a check mark next to each item that describes YOU.

AREA 1

_____ I like to listen to songs on the radio or a CD.
_____ I like to watch music videos on TV.
_____ I like to go to music concerts and hear live music.
_____ I can easily remember tunes, raps, or melodies.
_____ I take music lessons, singing lessons, or play a musical instrument.
_____ I can learn new songs easily.
_____ I like to sing.

AREA 2

_____ I like art classes.
_____ I like to draw, paint, and make things with clay.
_____ I enjoy putting puzzles together.
_____ I like to build things using blocks, Legos, and models.
_____ It is fun to play video games.
_____ I can create a picture in my mind to help me think things through.
_____ I notice the different styles of things, like clothes, cars, and hairstyles.

AREA 3

_____ I like to read books, magazines, and comic books.
_____ I have a good vocabulary and like to learn new words.
_____ I enjoy writing e-mails to my friends.
_____ I like to write.
_____ It is fun to play word games such as Scrabble and Mad Libs, do crossword puzzles, and acrostics.
_____ I think it would be fun to keep a journal of my thoughts and ideas.
_____ I like to talk to my friends on the telephone.

AREA 4

_____ I like to play with animals and take care of them.
_____ I like going to zoos, parks, or aquariums.
_____ I like being outside.
_____ I like to hike, walk, or run outdoors.
_____ I like to observe nature's changes, such as thunderstorms, rain, snow, and sunshine.
_____ I help to recycle and take care of our environment.
_____ I pay close attention to things in my environment such as trees, rocks, flowers, birds, bugs, and squirrels.

AREA 5

_____ I like to do science experiments and go to science museums.
_____ I find arithmetic and math problems interesting.
_____ It is fun to solve mysteries.
_____ Numbers are really interesting to me.
_____ I like games like chess or computer games that require thinking.
_____ I like TV shows like ZOOM, National Geographic, and Nova that talk about science and math.
_____ I can do math problems in my head and make good estimates.

AREA 6

_____ I like to dance.
_____ I like to play sports such as baseball, soccer, hockey, or football.
_____ I like to build models or do beading, sewing, macramé, or carpentry.
_____ I enjoy acting in plays or skits or playing charades.
_____ I like to move when I am thinking about things.
_____ I like activities such as the martial arts, tennis, running, jogging, biking, skateboarding, or gymnastics.
_____ I can sometimes "feel" the right answer.

AREA 7

_____ I like to be with my friends often.
_____ I like to help those who need help.
_____ I like to read books or see movies about people and their lives.
_____ I can usually tell how other people are feeling.
_____ It is fun for me to organize activities at home and at school.
_____ I would rather spend time with others than spend time alone.
_____ I like to talk in class discussions.

AREA 8

_____ I like doing things by myself.
_____ I would rather work by myself than with other students.
_____ I like to spend time thinking or writing about things that matter to me.
_____ I like to play computer games.
_____ I usually know what my feelings are.
_____ I like to write my thoughts and feelings in a diary or journal.
_____ I know what things I am good at, and what things I am not so good at.

Modified from http://printables.scholastic.com/content/collateral_resources/pdf/05/0439590205_e001.pdf

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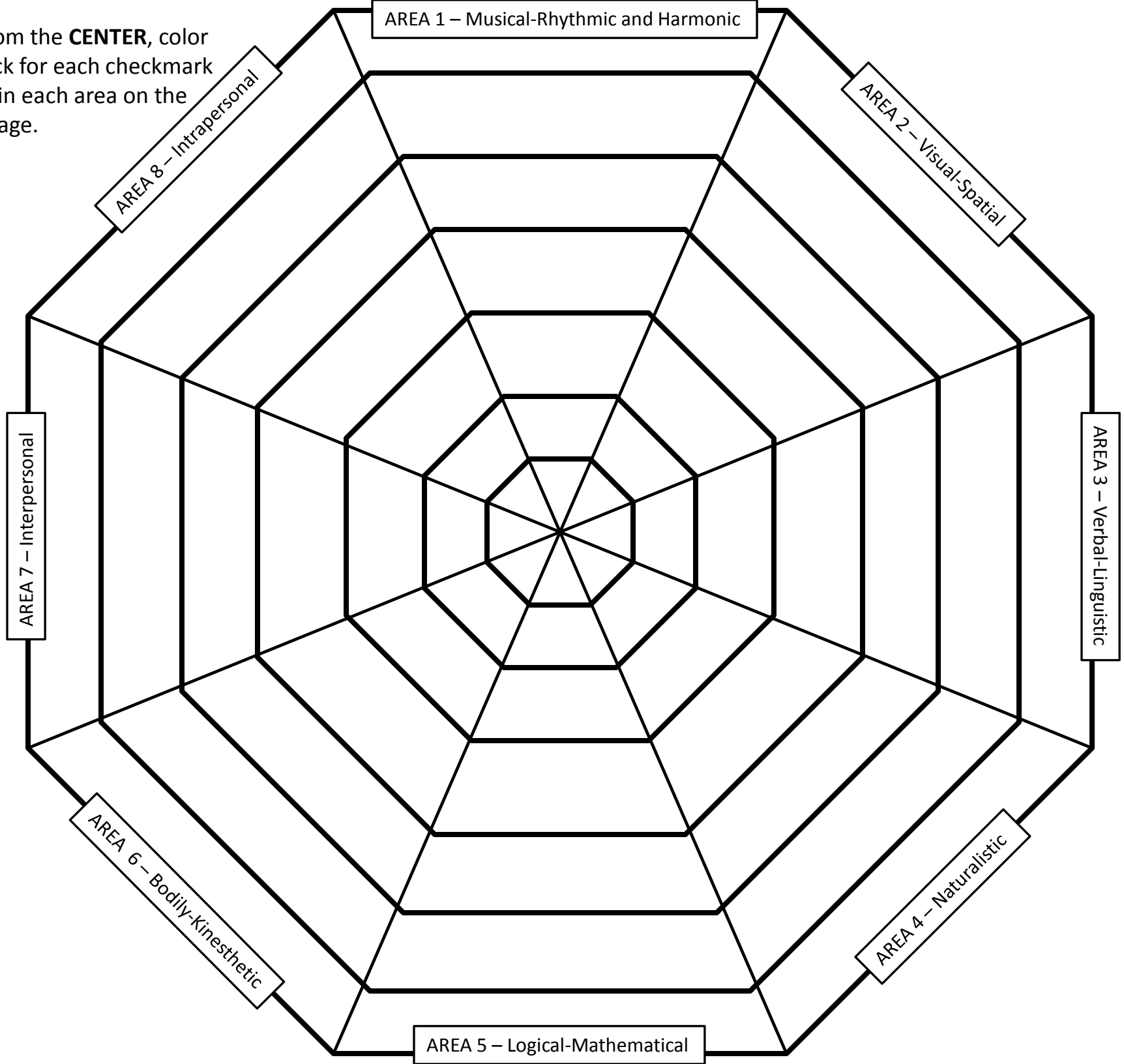

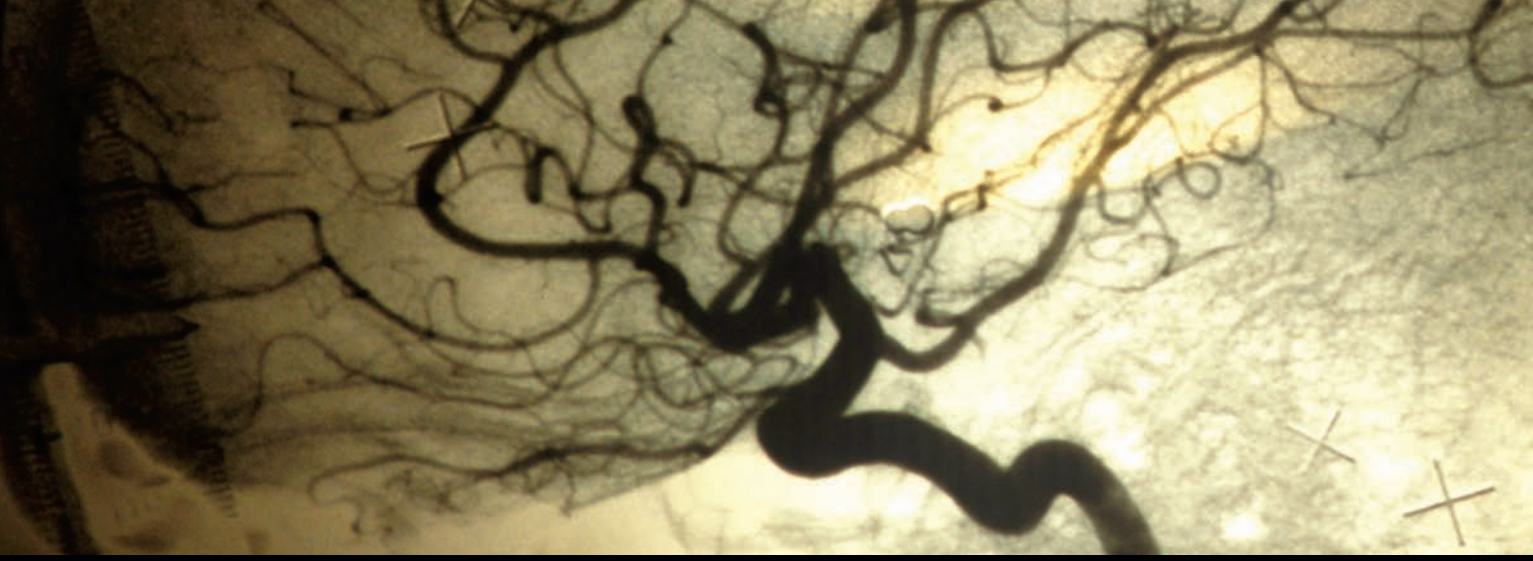

INTELLIGENCE

Linda Gottfredson

NewScientist

INSTANT EXPERT

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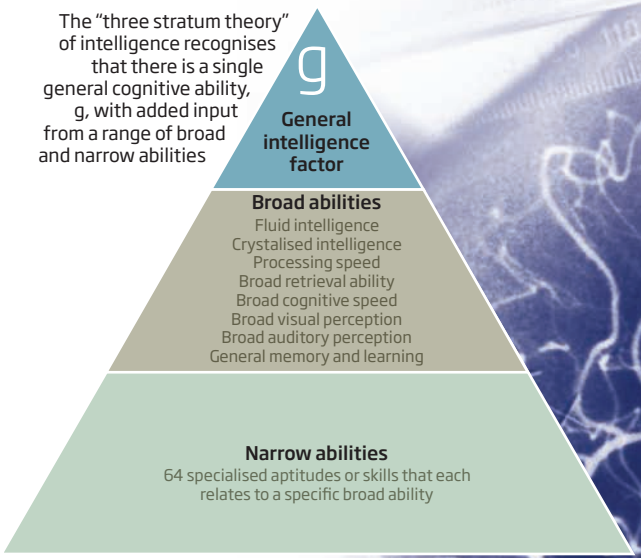
DIFFERENT TYPES OF INTELLIGENCE

Consider the engineer's superior spatial intelligence and the lawyer's command of words and you have to wonder whether there are different types of intelligence. This question was debated ferociously during the early decades of the 20th century. Charles Spearman, on one side, defended the omnipotence of his general factor of intelligence, g. On the other, Louis Thurstone argued for seven "primary abilities", including verbal comprehension (in which females excel) and spatial visualisation (in which males excel). Thurstone eventually conceded that all his primary abilities were suffused with the same g factor, while Spearman came to accept that there are multiple subsidiary abilities in addition to g on which individuals differ.

This one-plus-many resolution was not widely accepted until 1993, however. It was then that American psychologist John B. Carroll published his "three stratum theory" based on a monumental reanalysis of all factor analysis studies of intelligence (see Diagram, right). At the top is a single universal ability, g. Below this indivisible g are eight broad abilities, all composed mostly of g but each also containing a different "additive" that boosts performance in some broad domain such as visual perception or processing speed. These in turn contribute to dozens of narrower abilities, each a complex composite of g, plus additives from the second level, together with life experiences and specialised aptitudes such as spatial scanning.

This structure makes sense of the many differences in ability between individuals without contradicting the dominance of g. For example, an excellent engineer might have exceptional visuospatial perception together with training to develop specialist abilities, but above all a high standing on the g factor. The one-plus-many idea also exposes the implausibility of multiple-intelligence theories eagerly adopted by educators in the 1980s, which claimed that by tailoring lessons to suit the individual's specific strength – visual, tactile or whatever – all children can be highly intelligent in some way.



WHAT DO IQ TESTS MEASURE?

A century ago, British psychologist Charles Spearman observed that individuals who do well on one mental test tend to do well on all of them, no matter how different the tests' aims, format or content. So, for example, your performance on a test of verbal ability predicts your score on one of mathematical aptitude, and vice versa. Spearman reasoned that all tests must therefore tap into some deeper, general ability and he invented a statistical method called factor analysis to extract this common factor from the web of positive correlations among tests. This showed that tests mostly measure the very same thing, which he labelled the general factor of intelligence or "g factor". In essence, g equates to an individual's ability to deal with cognitive complexity.

Spearman's discovery lay neglected in the US until the 1970s, when psychologist Arthur Jensen began systematically testing competing ideas about g. Might g be a mere artefact of factor analysis? No, it lines up with diverse features of the brain, from relative size to processing speed. Might g be a cultural artefact, just reflecting the way people think in western societies? No, in all human groups – and in other species too – most cognitive variation comes from variation in g.

Jensen's analyses transformed the study of intelligence, but while the existence of g is now generally accepted, it is still difficult to pin down. Like gravity, we cannot observe it directly, so must understand it from its effects. At the behavioural level, g operates as an indivisible force – a proficiency at mentally manipulating information, which undergirds learning, reasoning, and spotting and solving problems in any domain. At the physiological level, differences in g probably reflect differences in the brain's overall efficiency or integrity. The genetic roots of g are even more dispersed, probably emerging from the joint actions of hundreds if not thousands of genes, themselves responding to different environments.

Higher g is a useful tool, but not a virtue. It is especially handy when life tasks are complex, as they often are in school and work. It is also broadly protective of health and well-being, being associated with lower rates of health-damaging behaviour, chronic illness, post-traumatic stress disorder, Alzheimer's and premature death.

Higher g helps an individual get ahead socioeconomically but it has little connection with emotional well-being or happiness. Neither does it correlate with conscientiousness, which is a big factor in whether someone fulfils their intellectual potential.

JOE MCNALLY/GETTY

WHAT IS INTELLIGENCE?

Intelligence matters to us. In surveys people rank it second only to good health. Women worldwide believe smarter men make better husband material. Entrepreneurs hawk brain-boosting games, foods, supplements and training programmes. And the media quickly broadcast any scientific study claiming to discover how we can make ourselves, or our children, smarter. Yet our keen private interest in intelligence is matched by a reluctance to acknowledge publicly that some people have more of it than others. Democratic people value social equality above all, so they mistrust anything that might generate or justify inequality – but intelligence is no more equally distributed in human populations than height is. This tension has led to rancorous controversy over intelligence and intelligence testing but it has also benefited the science by pushing it exceedingly hard. A century of clashes and stunning discoveries has upended assumptions and revealed some fascinating paradoxes. Intelligence is definitely not what most of us had imagined.

QUANTIFYING INTELLIGENCE

The first intelligence quotient (IQ) test was born of a desire to help the most vulnerable. In 1904 the French Ministry of Education commissioned psychologist Alfred Binet to find a practical way to identify children who would fail elementary school without special help. Binet assembled 30 short, objective questions on tasks such as naming an everyday object and identifying the heavier of two items. A child's performance on these, he believed, would indicate whether their learning was "retarded" relative to their peers. His invention worked and its success spawned massive intelligence-testing programmes on both sides of the Atlantic. Organisations turned to IQ tests to screen large pools of applicants: military recruits for trainability, college applicants for academic potential and job applicants for employability and promotability. The tests were eagerly adopted at first as a way to select talent from all social levels, but today their use can be considered contentious, partly because they do not find equal amounts of intelligence everywhere.

Nevertheless, intelligence testing continues because it has practical value. Many colleges, employers and the armed services still use paper-and-pencil or computer-based intelligence tests to screen large groups of applicants. The gold standard, however, is the orally administered, one-on-one IQ test, which requires little or no reading and writing. These include the Stanford-Binet and Wechsler tests, which take between 30 and 90 minutes and combine scores from areas such as comprehension, vocabulary and reasoning to give an overall IQ. These batteries are used to diagnose, treat or counsel children and adults who need personal or academic assistance. Ability testing is governed by detailed ethical standards and professionally administered tests must meet strict criteria including lack of cultural bias and periodic updating. In fact, IQ tests are the most technically sophisticated of all psychological tests and undergo the most extensive quality checks before publication.

Alfred Binet invented the IQ test to identify those schoolchildren most in need of help

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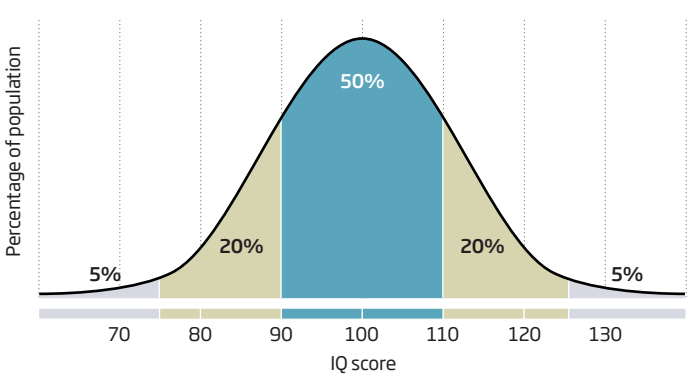
Average IQ score distribution by population



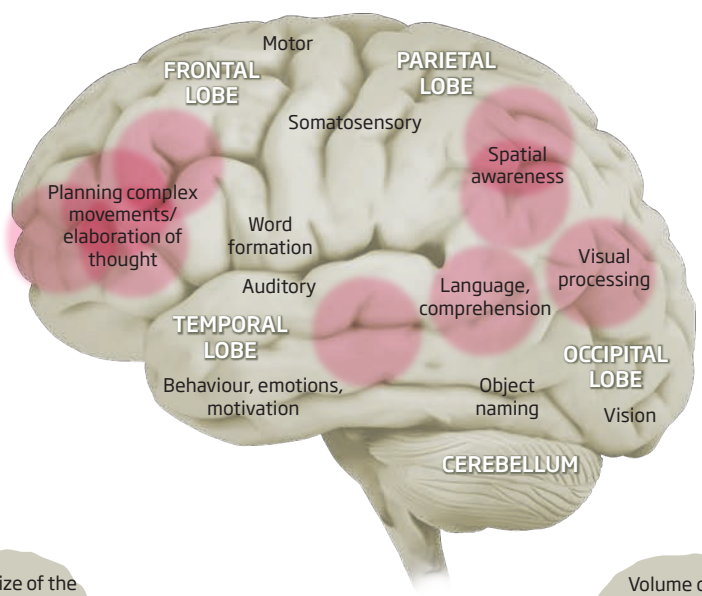
OLDER AND WISER

The brain is a physical organ and no less subject than any other to ageing, illness and injury. The normal developmental trajectory is that aptitude at learning and reasoning – mental horsepower – increases quickly in youth, peaks in early adulthood, and then declines slowly thereafter and drops precipitously before death. The good news is that some important abilities resist the downturn.

Some IQ researchers distinguish between tests of fluid intelligence (gF) and crystallised intelligence (gC). The first assess on-the-spot learning, reasoning and problem solving; the second assess the crystallised fruits of our previous intellectual endeavours, such as vocabulary in one's native language and broad cultural knowledge. During youth gF and gC rise in tandem, but they follow different trajectories thereafter. All gF abilities decline together, perhaps because the brain's processing speed slows down with age. However, most people's gC abilities remain near their personal peak into old age because they reside in the neural connections that gF has laid down over a lifetime of learning and practice. Of course, age-related memory loss will affect an individual's ability to recall, but exactly how this affects intelligence is not yet known.

This has practical implications. On the positive side, robust levels of gC buffer the effects of declining gF. Older workers are generally less able to solve novel problems, but they can often compensate by calling upon their larger stores of experience, knowledge and hard-won wisdom. But gC can also disguise declines in gF, with potentially hazardous results. For example, health problems in later life can present new cognitive challenges, such as complex treatments and medication regimes, which individuals with ample gC may appear to understand when actually they cannot cope.

There are ways of slowing or reversing losses in cognitive function. The most effective discovered so far is physical exercise, which protects the brain by protecting the body's cardiovascular health. Mental exercise, often called brain training, is widely promoted, but it boosts only the particular skill that is practised – its narrow impact mirroring that of educational interventions at other ages. Various drugs are being investigated for their value in staving off normal cognitive decline, but for now preventive maintenance is still the best bet – avoid smoking, drinking to excess, head injuries and the like.



Overall size of the brain, relative to the body, correlates with IQ

Volume of the cortex, the brain's grey matter, correlates with IQ

Intelligence requires integration of sensory and other information

Learning and experience can increase the size of specific brain areas

High IQ is associated with faster mental processing speed

Volume of tissue linking the brain's hemispheres correlates with IQ

WHAT MAKES SOMEONE SMART?

Intelligence tests are calibrated so that, at each age, the IQ average score is 100 and 90 per cent of individuals score between IQ 75 and 125. The typical IQ difference between strangers is 17 points and it is 12 between full siblings. Everybody accepts that intelligence varies. But what makes some people smarter than others? How do nature and nurture interact to create that variation as we develop? Are differences in g set at birth, or can we increase someone's intelligence by nurturing them in the right environment?

NATURE AND NURTURE

"Intriguingly, the heritability of intelligence is less than 30 per cent before children start school, rising to 80 per cent among adults"

Each of us is the embodiment of our genes and the environment working together from conception to death. To understand how these two forces interact to generate differences in intelligence, behavioural geneticists compare twins, adoptees and other family members. The most compelling research comes from identical twins adopted into different homes – individuals with identical genes but different environments – and non-kin adopted into the same home – unrelated individuals sharing the same environment. These and other studies show that IQ similarity most closely lines up with genetic similarity. More intriguingly, the studies also reveal that the heritability of intelligence – the percentage of its variation in a particular population that can be attributed to its variation in genes – steadily increases with age. Heritability is less than 30 per cent before children start school, rising to 80 per cent among western adults. In fact, by adolescence, separated identical twins answer IQ tests almost as if they were the same person and adoptees in the same household as if they were strangers. The surprising conclusion is that most family environments are equally effective for nurturing intelligence – the IQ of an adult will be the same almost regardless of where he or she grew up, unless the environment is particularly inhumane.

Why does the shared environment's power to modify IQ variation wane and genetic influences increase as children gain independence? Studies on the nature of nurture offer a clue. All children enter the world as active shapers of their own environment. Parents and teachers experience this first-hand as their charges frustrate attempts to be shaped in particular ways. And increasing independence gives young people ever more opportunities to choose the cognitive complexity of the environments they seek out. The genetically brighter an individual, the more cognitively demanding the tasks and situations they tend to choose, and the more opportunities they have to reinforce their cognitive abilities.

Given that an individual's ability to exploit a given environment is influenced by their genetic endowment, and given that "better" family environments tend not to produce overall increases in IQ, it is not surprising that attempts to raise low IQs by enriching poor school or home environments tend to disappoint. Narrow abilities can be trained up but g apparently cannot. This makes sense if g is an overall property of the brain. That does not mean intensive early educational interventions lack positive effects: among other things they may reduce rates of teenage pregnancy, delinquency and school dropout. Besides, even if we cannot boost low intelligence into the average range, we do know how to help all children learn more than they currently do and achieve more with the intelligence they have.

Identical twins are a natural laboratory in which to study how intelligence develops

LEFT GETTY; BACKGROUND DOUG CORRANCE/GETTY

REALISING YOUR ASSETS

IQ tests are designed to measure an individual's maximum cognitive ability but in everyday life we rarely perform at our best. Too often we arrive at work sleep-deprived, stressed, distracted, hungry, sick, addled by medicine or hung-over – all of which reduce cognitive acuity. This is compounded by the fact that many employers fail to recognise that mental performance varies over a day or week. Organisations squander their members' cognitive assets when they pace tasks poorly or flout normal sleep cycles, such as when schools start too early for the typical student, or when shift-workers have to put up with constantly changing schedules.

What's more, to fully realise their abilities, individuals of different intelligence levels often require different kinds of support. Educational and military psychologists have shown that people of below-average intelligence learn best when given concrete, step-by-step, hands-on instruction and lots of practice, whereas individuals of above-average intelligence learn best when allowed to structure their own learning. One-size-fits-all instruction stunts the learning of both types of individuals. Schools can get far more out of pupils by educating them to their personal potential and employers can boost the achievements of their staff with well-targeted assistance such as mentoring, supervision and training.

Brainpower also needs protecting and nurturing. Chronic illness, alcohol abuse and head injuries cause cumulative cognitive damage, accelerating the effects of ageing and increasing the risk of dementia. With vaccinations and care, most such assaults are preventable. We can also reduce exposure to human-made hazards that damage the brain, such as pesticides, lead, radiation and exposure to drugs in the womb. The best way to get the most from our native intelligence right into old age is to maintain good health of both body and mind. Healthy body, healthy mind is a cliché because it's true.

PLAINPICTURE/APPLY PICTURES

Brain training games can only improve particular skills but not overall intelligence

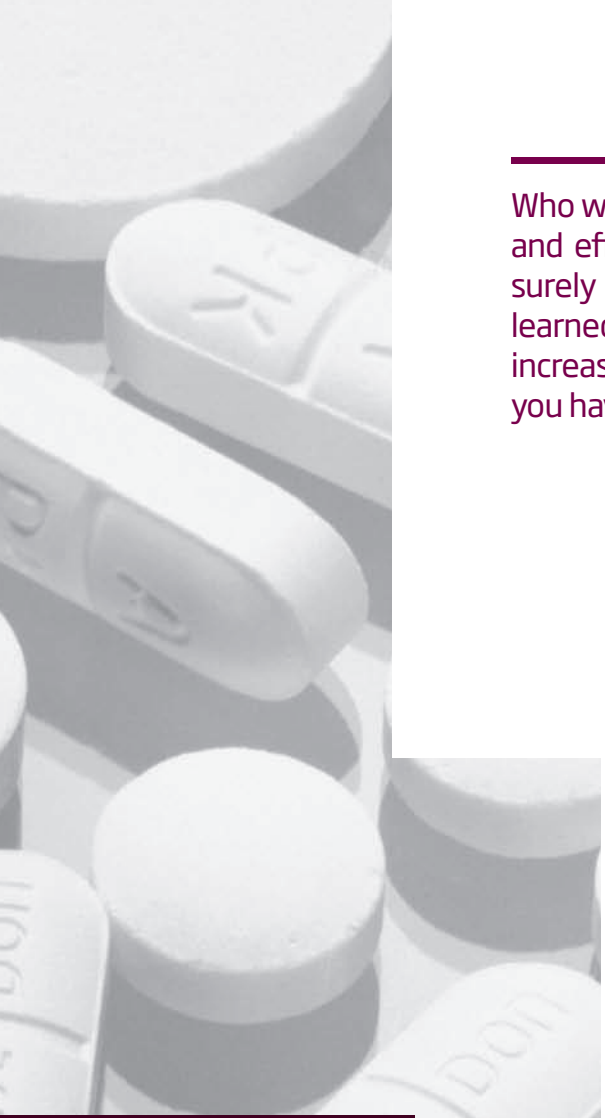
"As modern life becomes ever more complex, technological upgrades can feel like brain downgrades"

SIMPLIFY YOUR WORLD

Modern life is becoming ever more complex. When parents have to turn to their children to operate the latest electronic gadget, technological upgrades can feel like brain downgrades. The rising complexity of daily life can be a source of humour, embarrassment and inconvenience but, given that the ability to deal with cognitive complexity is the essence of intelligence, this complexity can also be detrimental to personal well-being. One largely overlooked way we can achieve more with the intelligence we have is to recognise this and try to reduce needless complexity in everyday life.

The potentially harmful effects of cognitive overload are particularly clear in the field of healthcare. High rates of non-adherence to treatments are the bane of medical providers, and these increase when treatment plans are more complex and patients less intelligent. Given the complexity of self-care regimes, it is hardly surprising that some people make dangerous errors or fail to comply. The effective management of diabetes, for example, requires a person to keep blood sugar levels within a healthy range, which means coordinating diet, exercise and medication throughout the day, which in turn requires planning for contingencies, recognising when blood sugar is veering too high or low, knowing how to regain control and conceptualising the imperceptible but cumulative damage caused by failing to maintain control. There is no set recipe for people with diabetes to follow – their bodies and circumstances differ. Moreover, they get little training, virtually no supervision and no days off. Effectively managing your diabetes is a cognitively complex job and poor performance has serious consequences, including emergency room visits, lost limbs or eyesight, and even death. The lower the diabetic person's IQ, the greater the risks.

Attempts to improve health outcomes in situations like this often focus on changing the behaviour of patients, but an equally effective approach might be to lower unnecessary cognitive hurdles to successful prevention, treatment and



self-management of illnesses. Many doctors are unaware that even a seemingly simple prescription medicine label or appointment slip may be incomprehensible to some patients. There is wide scope to simplify the cognitive demands on patients and to provide assistance with essential tasks that are inherently complex. And patients who are very susceptible to cognitive overload can benefit from triage, with healthcare providers identifying the behaviours most critical for success and then providing training, monitoring and feedback to ensure they are mastered.

In healthcare and beyond, managing cognitive overload is a great missed opportunity, a chance to reduce the risks of illness, accidents, and premature death by reshaping everyday environments to meet people's individual cognitive needs.

BOOSTING BRAINPOWER

Who wouldn't like to be more intelligent? If someone invented a safe and effective smart drug that could boost g by 20 points it would surely sell faster than Viagra. Unfortunately, everything we have learned about intelligence indicates that this is highly unlikely. If increasing intelligence is not an option, can you do more with what you have, by finding effective ways to work smarter, perhaps?

COGNITIVE ENHANCEMENT

Brain implants, transplants and downloads may be far in the future, but other forms of cognitive enhancement have a long history. For centuries people have used brain-boosting drugs. Caffeine and nicotine, for example, both increase alertness for short periods. Today there are more choices than ever. One recent survey of US universities found that as many as 25 per cent of students routinely take Ritalin or Adderall to boost memory and concentration – both drugs are actually designed to treat attention-deficit hyperactivity disorder. Another favourite is modafinil, licensed to treat narcolepsy and various sleep disorders, but which can also reduce fatigue and maintain alertness in healthy individuals burning the midnight oil. There are dozens more drugs in the pipeline with the potential for cognitive enhancement – some act on the same nicotinic receptors as cigarettes; others are being developed for the express purpose of augmenting memory.

Even if they are effective, however, such drugs do not increase intelligence, they only enhance certain aspects of cognition such as memory or alertness. And there may be unknown risks associated with them, particularly those that have been developed for other purposes and have had few trials on healthy people. However much we would like to boost our brainpower, many of us are not prepared to take these risks.

That might help explain the rise in recent years of so-called superfoods as a natural solution to cognitive enhancement. Unfortunately, while eating blueberries, salmon, avocados, and dark chocolate is obviously safer, it may not be as effective as many people hope. If such "brain foods" work at all, it is probably primarily by promoting general health when consumed as part of a wholesome, balanced diet.

In our desire to be cleverer we are constantly on the look-out for new cognitive enhancers. They range from the sublime, such as learning to play a musical instrument, to the impractical, such as transcranial direct current stimulation, which involves placing electrodes on the scalp to zap the brain with a tiny electrical current. Each claims to improve one or more specific abilities such as concentration, visual perception or memory, but the jury is still out on whether these improvements have real-world value.

Perhaps the most universally accessible brain toner is one of the most ancient – meditation. Growing evidence suggests that training in mindfulness meditation improves not just psychological well-being but also produces measurable improvements in a range of cognitive areas, including attention and memory, probably by reducing susceptibility to stress and distraction.

Superfoods may make you healthier but they won't increase your IQ

RIGHT PAUL SUTHERLAND/NGS BACKGROUND PLAINPICTURE/JOHNER

Linda S. Gottfredson

Linda S. Gottfredson is a professor of education at the University of Delaware in Newark. She focuses on the social implications of intelligence, including how cultural institutions are shaped by the wide variation in human cognitive capability that is characteristic of all groups. She is also interested in the evolution of human intelligence and especially the idea that it may have been driven by a need to overcome novel hazards associated with innovation

NEXT INSTANT EXPERT

David Sloan Wilson
GROUP SELECTION
6 August

ARE WE GETTING SMARTER?

Over the past century, each successive generation has answered more IQ test items correctly than the last, the rise being equivalent to around 3 IQ points per decade in developed nations. This is dubbed the "Flynn effect" after the political scientist James Flynn, who most thoroughly documented it. Are humans getting smarter, and if so, why?

One possible explanation is that today's world supports or demands higher levels of intelligence. Flynn himself suggests that intelligence has risen in part because we view life more analytically, through "scientific spectacles". However, the idea that cultural environments have potent and widespread effects on how smart we are does not square with what we know about the high heritability of intelligence. Environmental variation contributes relatively little to the IQ differences in a birth cohort as its members mature over the decades. How, then, could it create such big IQ differences across successive birth cohorts living in the same era?

Another theory puts rising IQ down to physiological changes. In the past century human height has been increasing in tandem with IQ throughout the developed world. Better public health measures have reduced the need for our immune systems to consume resources to combat infectious disease, leaving us able to spend more on growth – and larger, smarter brains may be just one consequence. Not only that, as more people travelled and married outside their local group, populations may have benefited genetically from hybrid vigour. Inbreeding is known to lower intelligence, and outbreeding can raise it.

It is also possible that the Flynn effect does not in fact reflect a rise in general intelligence, or g. After all, can the average IQ of adults at the end of the second world war really have been 20 points less than today? That would put them in the bottom 10 per cent of intelligence by current standards, making them legally ineligible to serve in the US military on grounds of poor trainability. It defies belief.

Instead of an overall increase in g, perhaps just certain biologically rooted cognitive abilities are increasing. An IQ test comprises a series of subtests, and it turns out that scores in some of these have increased a lot – including our ability to identify similarities between common objects – whereas others have not increased at all – such as scores in the vocabulary and arithmetic subtests. That would imply changes in specific brain regions rather than the whole brain.

The inter-generational rise in IQ test scores is a brain-twister for researchers trying to figure out what it means. Nevertheless, it does not undermine the use of IQ tests within generations. Current IQ tests are not intended to give an absolute measure of intelligence akin to grams and kilograms, but only to rate an individual's intellectual capacity relative to others born in the same year – no matter what the cohort, the mean score is always set at 100. As for the variation in g that IQ tests measure, it seems as wide and as consequential as ever.

RECOMMENDED READING

Intelligence: A Very Short Introduction by Ian Deary (Oxford University Press, 2001)

The Genetic and Environmental Origins of Learning Abilities and Disabilities in the Early School Years by Yulia Kovas and others (Blackwell, 2007)

The g Factor: The Science of Mental Ability by Arthur Jensen (Praeger, 1998)

Correcting Fallacies about Educational and Psychological Testing edited by Richard Phelps (American Psychological Association, 2009)

Intelligence, vol 24(1) (special issue called Intelligence and Social Policy)

Intelligence, vol 37(2) (special issue called Intelligence and the Brain)

Journal of Personality and Social Psychology, vol 86, p 96 (the Special Section on Cognitive Abilities)

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