all you need to get started

be a number genius

flash.

be a number
genius
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contents

We used to think that our brains simply faded away, the precious cells disappearing inevitably over time, like sand through an hourglass. The life-story of the brain was pretty depressing — until, in recent years, neuroscience began to paint a much rosier picture. The human brain was revealed to be 'plastic': still undergoing a great deal of change over a lifetime, due to environment and experience, but capable of changing for the better. The big news was that key areas could be physically strengthened by the way they're used. Suddenly we realized it was possible for us to rewire our brains to match our needs, boosting processing power and extending thinking skills. It was a thrilling idea, and the basis for the whole brain-training revolution.

But can the puzzles and exercises in books, newspapers and computer games really 'train your brain' as a whole — or do they just improve your skills at those particular challenges? Will brain training ever have any real impact on areas of thought that you *haven't* practised? Initial claims about the wide-reaching benefits of brain training — especially this very attractive promise of general improvement, or 'far transfer' — have been thrown into question recently by a number of studies. Doing Sudoku puzzles, crosswords or logic problems certainly makes you better at those things, but whether or not they help you improve in other tasks — even those that share some of the same elements — is unclear.

So, while there's good evidence about active minds staying active for longer, and even fending off the symptoms of some degenerative conditions, we just don't know yet if training really can build a better brain overall. But we're still very confident about the benefits of number training because our approach capitalizes on all the good news from neuroscience: the bits that have been proved beyond doubt.

Practising certain thinking tasks makes you better at them, and can strengthen those particular bits of your brain, so it makes good sense to stretch your mental muscles in every direction imaginable and to develop the widest possible repertoire of skills. Maths offers such a huge range of challenges, with all the key thinking strategies involved in a rich mix of connections and combinations. The puzzles, games and exercises in this book are designed to give your brain a full workout and to help you bring together all the core mental habits necessary for success. Crucially, to *keep* you practising them, we think the brain-training tasks you choose need to be interesting, stimulating, motivating and inspiring.

Repeating easy calculations at speed may be useful mental exercise, and there are plenty of books and games on the market that will provide you with long lists of questions. You can time yourself, improve your speed and accuracy, and help to keep your basic calculation skills sharp. But

we know that number training can go further than that — and *needs* to, if you're going to stay with it and enjoy the wide-ranging benefits on offer. There's so much more to maths than simple sums.

In this book we explore how maths can sharpen your thinking skills, showing why it's still important to have the key techniques at your fingertips. But times change, brains change, and the most exciting possibilities for us lie in what a number-trained brain can achieve today, going beyond individual calculations to achieve new levels of mental fitness and finding original and intriguing applications for mathematical thought.

Number training puts the ball firmly in your court. A baby's brain cells may have more interconnections than an adult's, but your older model has been customized to work in particular ways, its key areas developed and enhanced, and that process can continue throughout your life. Pioneer of brain research Wilder Penfield showed that an individual's thinking processes become mapped out in different designs, reflecting their unique experiences and needs. Musicians, for example, have more processing capacity relating to the body parts they use the most. Their mental maps for pitch and tone are bigger, the neurons better adapted to differentiating between sounds. Your brain is constantly adapting to the way you use it — so you'd better be using it well!

Training your brain with maths may lead to some helpful changes in your physical brain, but it will certainly sharpen a range of mental areas, including many of the abilities valued by traditional tests of intelligence — such as pattern-finding, code-breaking, orientation and reasoning. Rather than being about how far you went in your education, and the particular systems you may or may not have understood at school, being *really* good at maths involves visualization, memory, creative thinking... a repertoire of key thinking skills that can have a major impact on all the challenges you turn your mind to.

And at last our education system is catching on. There's a new emphasis in schools on mental maths, plus a commitment to teaching the core mathematical thinking skills, rather than just particular systems of calculation. Countries that delay the use of written methods are reporting impressive results, one theory being that their children are less bound by the 'rules' and more able to choose creatively from a range of possible approaches. It's a crucial ability to have. Have a go at the following three calculations in your head:

12 + 35 39 + 17 99 + 98

Three straightforward sums — but you may well have found yourself using three different calculating strategies. (The answers, by the way, are 47, 56 and 197.) Developing your mental flexibility is a key goal of number training. We hope you'll strengthen your understanding of the maths itself along the way, but even more important is your ability to

choose from all the strategies at your disposal. With practice, you'll become more aware of the relationships between numbers, able to spot patterns and parallels, to make clever choices about pursuing answers, and then to use them in the most effective ways.

We want to free you from any fears you might have about maths, so prepare to take a break from some of the written techniques you learned — or tried to learn — at school. Make sure you don't miss all the opportunities to develop the really important aspects of your mathematical thinking.

Visualization

Question 1: If you attach a string to the corner of an ice-cube and dangle it in a glass of water so that half of it is getting wet, what shape does it make in the water when you look down from above? (Don't worry if you don't get this one straight away; it's hard, but you can do it!)

Question 2: What number is below the 3 on your mobile phone keypad?

Question 3: How many different ways can you replace the drawer of a matchbox?

Number training will improve your ability to visualize: numbers, shapes, movement, pattern… and to pick out the key elements in any question you face. You'll understand more about what you're being asked and have new ways to manipulate information on the way to finding the answer.

Memory

The first 20 digits of Pi are 3.14159265358979323384. Give yourself two minutes to memorize them, using any technique that works for you, then cover the numbers and see if you can read them out from memory, in sequence, then in reverse order. What's the ninth digit after the decimal point? Which three numbers come before 323?

Question 4: Start with 1. Add 17. Divide by 3. Multiply by 2. Add 49. Subtract the number you started with. Divide by 4. Divide by 2. Multiply by 1,000. Add the number of days in March. Whatever number you have in your head now, add together all the digits. Find the square root, then divide by 4. What number do you get at the end?

At various points in the book, we explore the importance of memory in maths: remembering important numbers, recalling key facts memorizing useful techniques and tricks, and using memory strategies to hold digits in your head through all the steps of a mental calculation. Maths relies on memory — and many of the puzzles and exercises in this book provide excellent opportunities for keeping your memory skills sharp.

The 'extended mind'

This is a recurring theme in number training: the idea of using and incorporating the physical world in mental calculations. It links to kinaesthetic learning — learning by doing — but takes it a stage further. The aim is to use the body and environment to provide frameworks for thinking that can become internalized — 'built into' the brain.

Focused thinking

Maths helps you train your brain to identify the key facts in any sort of problem. You'll get better at separating the important bits from the red-herrings, intellect from emotion, and learn to recognize the habits of thought that can skew your understanding and wreck your calculations.

Logic

Maths is logical, and mathematical thinking is about making an argument that stands up to rigorous testing.

Creativity

How could you use a 30 cm ruler to measure the height of a tower block? You might divide the building into small sections and then use multiplication to find the total. What if you stood far back enough for the tower block to be exactly hidden behind the ruler: would that tell you anything? Perhaps you could do something with shadows, or the time it took for the ruler to fall if you threw it from the top floor — or simply offer the ruler as a bribe to the building's owner to tell you the answer.

Logic is central to number training, but there's still plenty of room for creativity. Creative calculating can save time, unearth new maths applications, and extend your thinking skills to solve other sorts of problems in original ways.

Every aspect of your maths will be boosted by honing visualization, strengthening memory, using your environment, focusing on facts, trusting logic, expanding creativity… and finding flexible ways to combine these valuable thinking skills. Crucially, these are all skills that can be applied to a range of other challenges in life, generating benefits at every turn, boosting overall mental confidence, and helping you to set up your brain for the success it deserves.

Within every chapter there are questions to stretch your thinking skills, plus a test at the end: ten maths challenges based on key themes from the chapter along with ideas to keep practising from earlier in the book. All answers can be found at the end of the book.

But before you start your training…

Test yourself now

Use the following questions to assess your existing abilities. Do your

best with each section, check your answers, and keep a note of your performance: how well you do, but also how good you feel about your skills. You'll be taking a similar set of tests at the end of the book to help you gauge just how far you've come.

Visualization

Question 1: You have six matches. How can you arrange them to make four equilateral triangles?

Question 2: Without rotating the page, what would the following sequences of numbers and letters look like upside down?

a) 96Npq b) 806sHb9 c) 9Xd60W86q

Question 3: How many capital letters have at least one line of symmetry?

Memory

Question 4: Spend one minute memorizing the following grid of numbers.

1	8	6	4
7	9	3	2
2	1	7	4
7	2	8	0

Now cover the grid and answer these questions from memory:

a) What are the digits in the four corners of the grid?

b) How many sevens are there?

c) Which number is above the nine?

d) What's the total of the four central digits?