

CHARLES PHILLIPS

# BRAIN BOOK

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MENTAL GYMNASTICS  
to TRAIN YOUR BRAIN

De Vecchi  
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DVE Ediciones

Charles Phillips

# **BRAIN BOOK**

Mental gymnastics to train your brain



DE VECCHI EDICIONES

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# INTRODUCTION

Remember how we were once told that our mental ability peaks at around age 18-24 and that it would be downhill from then on? We were warned that heading a ball during a game of soccer or drinking too much would accelerate our decline by killing neurons. We were told that if neural networks (webs of connected brain cells) were destroyed, they could never be remade. All this, it turns out, is untrue.

Scientists now know that the brain is a regenerating organ. If we use it, if we keep our brain cells firing and making new connections, then its powers will not dwindle. Even in our mature years, the brain can repair and regenerate itself. Your future is bright.

With this in mind, welcome to the *Brain Book*, the key to keeping your brain trim and your thinking lively. This little book contains a wealth of scientific facts about the brain, to help you appreciate just how powerful your thinking organ is and what astonishing feats it's capable of. And it's also full of specially designed puzzles and exercises that will challenge your brain and give it the training it deserves. Working your way through this book will help you achieve peak mental performance - whatever your age.

**Fulfil your potential** The typical brain has ten billion brain cells. When you think, when you learn something new, you forge connections within your brain. Each of your neurons connects an average ten thousand times with other brain cells, making a staggering total of one hundred thousand billion connections. Indeed, there are more connections in your brain than there are stars in the Milky Way galaxy.

## TACKLING THE PUZZLES

Throughout the book you will find puzzles and exercises designed to get different parts of your brain in gear. The more straightforward puzzles are

rated as one bar (see bottom left), but the rating of five bars (see bottom right) is reserved for only the most difficult of challenges.



As scientists have come to a more accurate understanding of the brain, they have realized that the potential of our thinking organ is truly staggering. The number of connections we are capable of forming is colossal. One estimate, made by Pyotr Anokhin and quoted by expert Tony Buzan, is the number 1 followed by ten million kilometres (six million miles) of 0s. So the potential connections outnumber atoms in the universe. This should give you some idea of your potential.

**We are getting younger** If you are of mature years, you may be younger than you think! In terms of life expectancy you are younger than your grandfather or mother was at your age. Moreover, armed with the latest knowledge on how your brain works, you have a much better chance than your grandparents had of keeping fully alert in later life. So read through the *Brain Book* and prepare to marvel at the power of your grey matter.

Neuroscientists and brainpower experts will also tell you that your perceptions – the way you see reality – are among the most important elements of your thinking. If you believe ‘I am getting older and feeling tired, my memory is beginning to fail and my mind is falling apart’, then you’ll probably begin to make these imagined effects real. But if you think, ‘Whatever age I am, my mind can be alert and fully stimulated if I take the trouble to keep it active’, you have already started to protect your brain from decline.

**The *Brain Box* puzzle** The wooden puzzle in the box consists of a neat six-sided cube, made from 27 smaller cubes. Unravelling it is easy, but fitting it back together is quite a challenge! The puzzle provides a good visual-spatial

workout – helping your ability to think in three dimensions – as well as boosting your overall powers of thought. To solve it, you will need patience and imagination to find fresh perspectives.

### **THINK YOUNG!**

Research shows that over-65s can reduce their mental age by 14 years through brain training with problem-solving and puzzles.

## **UNDERSTANDING YOUR BRAIN**

To get the most out of training the brain, we need a little background knowledge. What is thinking? Why do we feel emotions? How does memory work? What are lateral thinking and intuition? This know-how will help us plan a mental gymnastics routine to stretch the brain's many high-powered capabilities.



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## A short history of the brain

Our early ancestors did not associate the brain with memory, intelligence and other mental faculties - they thought of the mind rather as a disembodied spirit. The ancient Egyptians, for example, revered the heart as the centre of intelligence and saw the brain largely as an unimportant organ.

In the first millennium BCE the ancient Greeks were the first to link the brain with the mind: in the 6th century BCE Alcmaeon declared that intelligence resided in the brain, while in the 5th century BCE, Plato suggested that the brain recorded impressions from experience, like mouldings pressed in soft wax. But his most famous student, Aristotle, followed the Egyptians in believing that the heart was the organ of thought while the brain's job was to cool the blood.

Herophilus, a Greek anatomist working in the north African city of Alexandria in the 4th-3rd centuries BCE, identified the brain's ventricles (spaces in the brain that carry protective and nourishing cerebrospinal fluid) as the locus of our thinking power. This theory was taken up in the 2nd century CE by Galen of Pergamum, then transmitted to Europe by Arab physicians and generally accepted for hundreds of years.

**The nervous system** Only in the 18th and 19th centuries did researchers begin to understand the brain's role in the nervous system; some, including the German anatomist Franz Gall, drew maps tracing which part of the brain was linked to which activity. But by the mid-20th century this model had been shown to be too simple - and scientists such as Karl Spencer Lashley were arguing that the whole brain was involved in the more complex processes of the mind.

But much remained hidden. The brain's awesome power, self-regenerating capacity and almost limitless expandability were secrets waiting to be discovered.

### **NEW MODEL BRAIN**

In evolutionary terms, the brain is a recent invention. Life on Earth dates back 4,500 million years, *Homo sapiens* are three million years old, but the modern brain evolved only 50,000 years ago.

### **What is the brain?**

The brain is the body's control centre. Not only does it run complex mental activities, such as learning a foreign language or doing mind-bending puzzles, it also controls your digestion, breathing and other largely subconscious body functions, and commands your deliberate physical actions such as working out at the gym. This prodigiously powerful organ weighs on average 1.5 kg (3 lb) in a man and 1.25 kg (2 lb 12 oz) in a woman - a difference due to the average variation in body size between the sexes.

Most of your mind's processes are controlled in the cerebral cortex - the wrinkled surface of the brain that looks like a walnut. The cortex, which covers the brain's largest part, the cerebrum, is 'cell-heavy': despite taking up only one-quarter of brain volume, it contains 75 per cent of its cells.

### **THIRSTY WORKER**

Although the average brain accounts for just one-fiftieth of an adult's body weight, it uses a fifth of the oxygen in the blood.

The brain contains left and right hemispheres. These are cross-wired: the right hemisphere controls the left side of the body, while the left half commands the body's right side. Researchers have also shown that the 'right brain' appears to control artistic activities, while the 'left brain'

commands logic, maths (math [Amer]) and language ([see pages \\*](#)).

Each hemisphere has four areas called 'lobes'. The frontal lobes control thought and planning. The other lobes - at the side, top and rear - help control the senses and govern language. Scientists also sometimes distinguish between 'the upper brain' (the cerebral cortex), which directs mental activities, and the 'lower brain' (including the midbrain, cerebellum and brainstem), which primarily control bodily functions, emotions, sexual urges, and instincts such as the 'fight or flight' response, which prepares us for action when we perceive danger. The upper brain appeared at a later evolutionary stage and is sometimes called the 'new brain'.

The latest research indicates that most mental activities involve many different parts of the brain working together.

### **How brain cells connect**

Your brain contains an amazing ten billion cells, called neurons. Each cell has a round centre containing its nucleus, with a cluster of tentacles at one end like the branches of a tree (called 'dendrites', from the Greek for 'tree') and at the other end a long shoot called an 'axon'. The axon branches out at the end to make connections with other cells. These connections are actually made across tiny gaps called synapses. A cell sends information in the form of electrical impulses along its axon, generating a chemical transfer across the synapse to another brain cell. The process sparks a reaction in the cells, creating a network of connected cells.

**Making new connections** The crucial thing to know is that when you learn something new you make new connections between cells, forging new neural pathways. This improves your general mental powers. Researchers have identified more than fifty different chemical messengers ('neurotransmitters') involved in the lightning-quick movement of information through circuits of brain cells.

When we alter our 'brain chemistry' by having a coffee or a couple of glasses of wine we alter the activities of these chemical messengers.

**Brainwaves** The more you use your upper brain, the more the brain cells are firing, and the more electricity the brain generates. Using electroencephalograph (EEG) machines, researchers have identified four levels of electrical activity, each distinguished by a pattern of brainwaves. When alert and fully engaged, your brain emits beta brainwaves (14 to 40 cycles per second). At rest after activity, you have alpha brainwaves (9 to 14 cycles). Theta brainwaves (5 to 8 cycles) occur when you are 'on automatic', while delta brainwaves (1.5 to 4 cycles) occur only in deep, dreamless sleep.

### **BRAIN CHEMISTRY**

Every second, an astounding 100,000 chemical reactions take place in your brain. The electrical impulse sent by a neuron lasts 1/1000th of a second and travels at up to 200 mph.

### **A history of games**

From time immemorial people have enjoyed the challenge of mental tests, puzzles and games. Small clay labyrinths like tiny mazes were popular with the ancient Indus civilization of northern India and Pakistan in around 2600 BCE. At about the same time, the inhabitants of the ancient Mesopotamian city of Ur played board games similar to Ludo. In ancient Egypt (from the 2nd millennium BCE on) people passed the time with games like backgammon.

The oldest surviving puzzle is the *loculus* - attributed to Archimedes, the 3rd-century BCE Greek mathematician. Players rearrange fourteen shapes to form a square or other formations. It is extremely difficult, so is also known as the *stomachion*, the 'maddening problem'. The ancient Chinese played a related seven-piece puzzle called the tangram.

Over the centuries, human ingenuity and love of games fired the development of a dazzling variety of games and puzzles. Many derived from teaching tools. The jigsaw puzzle, for instance, developed from the 'dissected maps' made by 18th-century London engraver/map-maker John Spilsbury. The celebrated Rubik's cube came from a puzzle developed by Hungarian Ernő Rubik in the 1970s to help architectural students practise three-dimensional visualization (did you know there are forty-three billion billion possible arrangements of the Rubik's cube?).

Other puzzles were developed just for fun - like the crossword puzzle, developed by an English emigrant to the USA, Arthur Wynne, first published in *Fun*, on 21 December 1913. The British developed the much more difficult 'cryptic crossword'. The first, by 'Torquemada', was published on 30 July 1925 in the *Saturday Westminster*.

**American pioneer** Sam Loyd is remembered as America's greatest puzzle writer. He began publishing chess problems in the mid-1850s and progressed to mathematical and three-dimensional problems. He invented many types of maths brainteasers, published several compendium-books of puzzles and also worked as a ventriloquist.

## **Brain training**

Human beings derive satisfaction from measuring up to a challenge, and most of us have a playful element somewhere in our characters that takes pleasure in games. Giving ourselves a mental workout is not only enjoyable, it is also beneficial for the brain and for our general health.

Noradrenalin is a chemical in the brain associated with stress. Too much can be damaging, making you anxious and overly alert so that you cannot sleep, and preventing your brain from functioning effectively. But a little stress - the kind provided by a challenging puzzle - is a good thing. Released in moderate amounts, noradrenalin improves the

speed and effectiveness of connections between the brain cells.

So your mind functions better when you are slightly stressed. Meeting a challenge also boosts your physical health and general state of mind. The sense of achievement you feel at having mastered a difficult puzzle, say, is associated with the release of beneficial brain chemicals that lift your mood and raise the performance of your immune system.

**Use it or lose it** As we have seen, the former conventional wisdom – that we are doomed to gradual decline in our brain performance because our inborn supply of brain cells gradually dwindles year by year – is untrue. Doctors now know that the more we forge new connections between our brain cells, the better our mental performance will be. The most effective way to maintain brainpower is to use the brain and to provide it with fresh types of challenge.

**Stimulate yourself** Research in Chicago indicates that people with a mentally demanding job or a lifestyle that continues to provide them with real brain challenges, perhaps through doing puzzles and crosswords, are around 50 per cent less likely to succumb to Alzheimer's or other forms of dementia. Your brain stays young if you keep it active.

Meeting interesting people is another way to keep your brain alert. Scientists have shown that isolated animals have poorer mental functioning than those in a group. This applies particularly to human beings, who evolved as a 'social' species.

## **Ways of thinking**

Do you ever think you are so different from your child or parents you may as well be a separate species? Well,

children and teenagers *do* have quite different brains from older people.

**Wiring matters** For one thing the young are not fully wired – the brain’s frontal lobes, which govern mental control processes, do not fully develop until the early-to-mid 20s. We are also the product of what we have thought. Firing and connecting brain cells, stimulated by experience and knowledge, create patterns of connections that change the brain permanently.

What are the effects of this on how we think? At different life stages we tend to have different ‘thinking styles’. Children up to the age of twelve, for example, like to consider things in terms of concrete reality rather than abstract ideas. They recognize none of an adult’s accepted boundaries and so can be extremely creative. They love to ask ‘Why?’

Teenagers tend to have a highly developed sense of justice and of logic, and a desire to work out all the consequences. Driven by idealism, they do not understand the compromises that many adults have accepted. Like children, they question assumptions. They are fearless explorers of the mind.

**The adult brain** Adults have a wealth of experience and a brain wired with diverse connections at their disposal. They may have challenging work and a rich and varied life to keep them on their toes. The frontal lobes, now fully developed and functioning, give an enhanced capacity for self-control and foresight – predicting outcomes and adjusting activity accordingly. On the other hand, adults stuck in routine may find their memory failing or their powers of self-expression decaying. This is probably because they are not exercising these faculties. But there is no need for such mental decline.

Adults and pre-adults have plenty to learn from each other. Older thinkers can sometimes benefit from the unfettered, mind-bending approach of the young, while the less mature could sometimes do with adopting the focus and self-discipline shown by their older counterparts.

## **How to train your brain**

The Irish playwright George Bernard Shaw declared: 'We don't stop playing because we grow old, we grow old because we stop playing.' You can choose from a wide variety of games and puzzles to give your brain the regular workout it needs to keep its neurons firing.

Visual and three-dimensional puzzles like printed mazes or the wooden puzzle included with this book help you to forge and reinforce neural pathways connected to visual and spatial awareness. Lateral thinking exercises are a way of developing creative problem-solving, the 'no boundaries' thinking of the 'young-at-mind'. Chess and backgammon boost strategic and counter-intuitive thinking. Attempting anagrams or crosswords or playing Scrabble™ reinforces your vocabulary and encourages you to practise creative thinking.

All these pastimes enable us to develop skills and thinking strategies that are useful in work and other day-to-day activities. And they are an investment for the future. Because by keeping our brains busy with challenging and unfamiliar problems, we are greatly increasing the likelihood that our faculties will stay sharp far into old age.

**'Work hard, play hard'** Novelty is key – keeping day-to-day life fresh and surprising helps us stay alert. Repetition makes us less attentive, but when we try something different we often feel more alive and more engaged.

And according to the latest neuroscientific thinking, when we are engaged and attentive, we are boosting our brainpower. When we attend to something new and

stimulating, not only do we make fresh connections between brain cells, but the brain also releases chemicals called neuromodulators, which reinforce these connections.

### **CHANGE YOUR PERSPECTIVE**

Look for mind-stretching variety in your day-to-day life. Buy different newspapers to get a fresh perspective. Choose a novel by an author you have never read before. Download a few songs by a band you don't know. Or try meditation ...

### **Making sense of the world**

We need a range of mental faculties to make sense of the world, to establish and maintain our self-image and to plot a path through daily life.

We have our general intelligence and powers of thought, which allow us to compare and classify, to sequence and compartmentalize. Using our general intelligence, we marshal logic, engage in lateral thinking and test the leadings of our intuition.

We have our perceptions - the brain's interpretation of what we see, hear, taste, feel and smell around us. In terms of our mental life, these are the raw material of thought.

We have language and numerical skills, which we use to describe and label the world and our own response to it. We have our emotions, generated in our lower brain, experienced through physiological effects such as a raised heartrate or breathlessness and interpreted as 'fear' or 'envy' in the upper brain. [Emotions](#) are deeply involved in even the most rational of thought processes.

And we have memory, which maintains a record of the past inscribed in millions of cross-wired, connected brain cells. In a sense the memory is the keeper of our identity. If we suffered a terrible emotional trauma or physical injury that deprived us of our memory, we would have to rebuild entirely our sense of who we are. And, unless the memories returned, we would never know whether we were essentially

the same person as before, or not. Philosophers have spent many years discussing just such issues.

**Brainpower** In daily life we rely on the faculties working together. We make sense of our perceptions, emotions and memory using our linguistic capacity and general intelligence. But as we train our brains, each area can be developed and exercised separately. For this reason, in the following pages, the faculties of general thinking, perception, language, the emotions and memory are considered in detail one after the other, with creative and light-hearted puzzles tailored to develop skills and capacity in each area.

## **Learning to think**

Some experts believe that the ability to think is a product of your general intelligence, and that this is determined by the genes you inherit. But there is increasing evidence to suggest that thinking is a skill learnt and practised.

**IQ and other tests** Intelligence Quotient tests - better known as IQ tests - claim to measure your general intelligence compared to other people of roughly the same age. They involve a set of standardized tests that measure visual-spatial, verbal, numerical, perceptual and other forms of intelligence. When first developed, such tests provided a measure of your 'mental age', and your IQ was worked out by dividing your mental age by your actual age, then multiplying by 100. Modern tests calculate your IQ level on the basis of statistical figures for intelligence levels in populations.

IQ tests are a vast, multi-million-dollar industry. But some modern psychologists doubt their accuracy and usefulness, arguing that intelligence cannot be measured neatly on a scale, and that the tests have been created without anyone defining the quality - 'intelligence' - that they claim to

measure. Most tests, they suggest, measure what people have learnt rather than their mental potential, and many favour people from dominant cultural and racial groups.

Modern IQ tests were developed in the USA from the Binet-Simon Scale, devised in 1905 to identify children who needed extra help. Alfred Binet himself warned against using his scale for more general intelligence testing. He also argued that intelligence, far from being a fixed 'quantity' inherited from your ancestors, was a fluid and living ability that could be developed through practice and by learning relevant skills.

There is a growing consensus that you can improve thinking skills through doing mind-stretching puzzles and games.

### **PUSH YOURSELF!**

Try something different - develop your skills in areas where you find it harder to perform and where, perhaps for that reason, you do not normally go.

### **Practice makes perfect**

Here and now we have the capacity to hone our thinking skills, and increase our levels of mental alertness. All we need is the will to do it and the appropriate tools - such as the puzzles and exercises on the pages that follow.

It is common knowledge that if you don't use the muscles in your arms they grow weaker, whereas if you exercise them - in a gym workout, doing the housework, keeping the garden beautiful - they become stronger. Think of your brain as a muscle. It too needs a regular workout. To maintain good mental performance - to keep the memory sharp and thinking clear - use your brain in unusual and varied ways.

**Variety is the spice of life** Have you noticed that sometimes when you visit a new place on holiday, time seems to slow down? A few days is a satisfyingly long time. But when routine dominates your life, several weeks go by

in a flash. This is because when you are immersed in fresh experiences, you are more attentive - and alive. Your brain is more engaged.

**Do something different** Take this opportunity to try something different. Puzzles have a way of surprising you, of stretching your thinking. This will keep you alert. But above all, have fun. Start by attacking the exercises on [pages \\*](#), which offer a gentle introduction to the joys of puzzling. Trying them out will tone your brain muscle. The more variety, the better the exercise for your brain - and the more new connections you will make among your brain cells.

That's why I recommend that you do puzzles and exercises you'd normally avoid. Tackle the number puzzles even if you think you can't add up. Enjoy the spot the differences even if you don't normally think of yourself as a perceptive person. You'll probably do better than you expect. And if not, keep trying.

### **TAP INTO YOUR POTENTIAL**

Scientists suggest that even the most diligent and mind bendingly brilliant people use less than 1 per cent of the capacity of their brains.

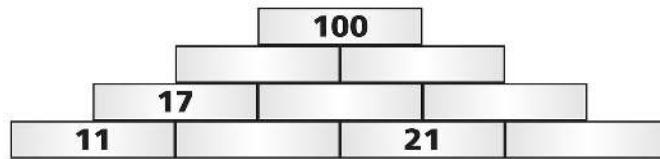
# Mixed puzzles

## Puzzle 1

### NUMBER PYRAMID



This numerical challenge needs a bit of logical reasoning. Each block in this pyramid is equal to the sum of the two numbers beneath it. Can you find all the missing numbers?



[Answer](#)

## Puzzle 2

### WORD POWER



Anagrams are a good test of your word power. Can you unravel this one to find a cartoon hero?

**r o m e m o p s s h i n**

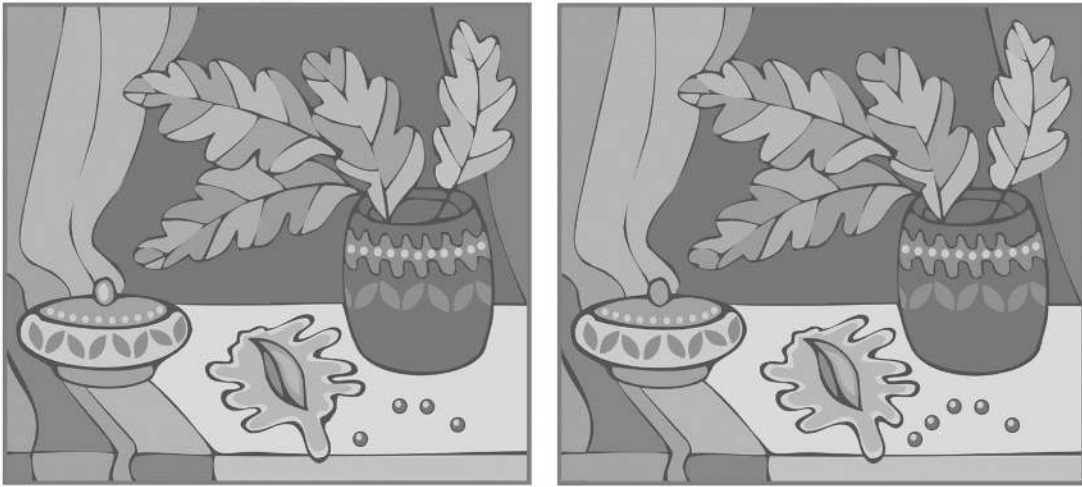
[Answer](#)

### Puzzle 3

#### SPOT THE DIFFERENCE



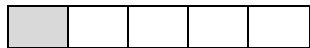
Often our eyes are tricked into seeing what we want to see. But those who are perceptive will be able to spot the seven differences between these two pictures. Circle them in the drawing on the right.



[Answer](#)

## Puzzle 4

### TIME TO EAT?



Three children are having lunch. Each has a different sandwich and a drink. Can you work out who ate what from the two clues given opposite? The box explains how best to tackle logic puzzles. Once you master the art you'll be able to use your brainpower to tackle more difficult puzzles and really stretch your logical mind. These puzzles are addictive!

	CHICKEN SANDWICH	HAM SANDWICH	CHEESE SANDWICH	ORANGE DRINK	LEMON DRINK	LIME DRINK
JOHN						
JULIE						
JERRY						
ORANGE DRINK						
LEMON DRINK						
LIME DRINK						

### TIME TO EAT? (CLUES)

- 1 Jerry has a cheese sandwich but not a lemon drink.
- 2 Julie isn't the child with both an orange drink and a ham sandwich.

#### How to solve logic puzzles

The trick to solving logic puzzles lies in deducing what is known for sure from the information you've been given. First, unravel the information in the clues to work out what is valid and invalid, then deduce further information. It is useful to add ticks or crosses to the grid, as shown, according to what you know to be true or untrue.

In this example, three sisters are taken on an outing by either their Mother, Father or Aunt to either a restaurant, a beach or a museum. In this case we know that Jane wasn't taken out by her Mother or Father, so must have gone out with her Aunt. Anna didn't go out with her Father and she didn't go to the beach. Louise must therefore have gone out with her Father as none of the other girls did. In this way, using the clues, it is possible to deduce all the information you need to complete the grid.

	JANE	ANNA	LOUISE	RESTAURANT	BEACH	MUSEUM
MOTHER	X					
FATHER	X	X			X	
AUNT	✓					
RESTAURANT						
BEACH		X				
MUSEUM						

**Answer**

## What is perception?

Imagine a woman walking on a winter morning along a snowy lane. She looks up at the blue sky, and across at the tree branches, which appear starkly black against the whiteness of the snow-covered fields. As she walks, she hears the crunch of the snow beneath her feet and perhaps the song of a bird and the drone of an aeroplane. She feels the cold biting her hands when she takes her gloves off and tastes something of the frozen night still afloat on the winter air.

She experiences the morning through all her senses simultaneously. And when she does look, she is seeking patterns and meaning around her. Her brain interprets the flow of light photons hitting her retinas and 'creates' this winter postcard scene on the basis of known patterns in previous experience. A recently born baby, with still-developing eyesight and brain, would have a quite different experience of the flood of light, a quite different reality.

Many psychologists and philosophers declare perception to be the most important aspect of our thinking. Our way of seeing determines how we look at the world and what things we take into account. It determines the patterns we look for in sensory experience and information and therefore the meaning we extract from them.

This insight is liberating. It means we can change. And changing our perceptual mind-set transforms our way of seeing, in turn transforming our way of being. I may think 'I can't do mathematical problems'. But when I try them, I may find I am better than I anticipated - and certainly when I persevere with them, I will improve my level of skill.

**Seeing patterns** You have just taken delivery of a new car and invite your friend along for a trial run. As you drive, you notice several other drivers at the wheel of your make of car, some driving your model, others driving older ones. You

mention this to your friend, who says she hasn't noticed. You realize that only a couple of weeks ago, before you bought this car, you probably wouldn't have noticed either. Your perception - your experience of reality - would have been different.

## **Varying perceptions**

At the age of ten, the English poet William Blake told his father he had seen a group of angels in a tree in Peckham Rye, south London. Was he mad? Did he really see them? Had his father been with him at the time, would he have seen them?

'If the doors of perception were cleansed,' Blake wrote later, 'everything would appear to man as it is: Infinite.' He argued that we are prevented from seeing reality as it actually is by our habits of perception.

Religious mystics agree with Blake, declaring - on the basis of their own experience - that we see reality with imperfect vision, but that, perceived in a new way, or with our current way of seeing dramatically improved, the world appears unified, sacred, limitless, full of meaning. Most people, however, have a much more mundane view of life on Earth. Whose reality is real?

If angels exist, it is probable that only people who believe in them can see them. Not only do people sometimes have quite different perceptions of the same reality, but also - psychologists point out - they may not perceive something at all if it is completely unfamiliar, or does not fit in with their preconceptions. They may develop a 'blindness' for something that is there.

This is as true in the world of ideas as it is in the world of trees and Peckham Rye (and angels?). We may limit our capacity for problem-solving, adaptive reasoning and creative thinking - in the workplace, when discussing what is dear to us, or when playing games or doing puzzles - by