you can learn to remember

Change Your Thinking, *Change Your Life*

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Dominic O’Brien is renowned for his phenomenal feats of memory and for outwitting the casinos of Las Vegas at blackjack. He has won the World Memory Championship eight times, holds a host of world records and was named Brain of the Year in 1994 and Grandmaster of Memory by the Brain Trust of Great Britain. He is President of the World Memory Sports Council. His books include *Learn to Remember* and *How to Develop a Brilliant Memory Week by Week.*

This book is dedicated to everyone who takes part in mind sports.

"Hi, Dominic. How come you're entering this year? I hear you're forty-two years old." This w the question asked of me by a seventeenyear-old American student on the first day of the 1999 Worl Memory Championships. I was told that he had been training his memory for six hours a day for th past six months and was in London for one reason and one reason only: to become World Memor Champion.

Although I believe his opening question was part gamesmanship, many people would argue th this was, in fact, a fair comment. A bright, seventeen-year-old college student should certainly hav the edge over a forty-two-year-old codger like me. After all, isn't the memory capacity of a huma being supposed to decline with age?

Up until 1988, if someone had asked me that question, I would certainly have answered "yes". giving that answer, I would have been echoing a popular misconception about memory – that old ag and forgetfulness are synonymous. But, in 1988, I was to witness an event that would change my life watched a man called Creighton Carvello memorize a randomly shuffled deck of playing cards in ju under three minutes – a feat of memory which put his name in the record books. I was dumbstruc How could anyone connect 52 unconnected pieces of data together, perfectly in sequence, usin nothing but their brain, in such a short space of time? Inspired and fuelled by a burning desire uncover Creighton's secret, I armed myself with a deck of cards and began a three-mon investigation into the potential of my own memory. What followed was an object lesson in accelerate learning. A process of natural selection took place as I threw out ideas that failed and refine techniques that produced results. As each day passed I felt as though I was awakening a giant with me. For the first time in my life, not just my memory, but also my powers of concentration an imagination, were beginning to reveal a potential that I never before realized they had. Unwittingly, was discovering the art of memory and memory techniques as practiced by the ancient Greeks mo than two thousand years ago.

setting your sights

On the first day of your memory training, you may remember only two or three items from a list. By the next day, you may recall as many as 10; by the following week, 20. Here are a few world records to aspire to!

In 1999 I memorized the order of 18 decks of shuffled playing cards (936) in one hour without a single error. In 2002 at Simpsons-In-The-Strand, London, I memorized a random sequence of 54 decks. All 2808 cards were shuffled into each other and I had only a single sighting of each card. I recalled the entire sequence with just eight errors. This is the current world record for the most cards memorized after a single sighting. Ben Pridmore holds the current record for the fastest time to memorize one pack of 52 playing cards, which he did in 24.68 seconds in 2008.

After three months of memory training I felt that I had been given a new brain. Soon after, I wa entering the record books myself by memorizing not one, but six randomly shuffled decks of playin

cards from a single sighting of each card. While I was amazed and impressed by my own brain capacity, I felt at the same time immensely bitter that I had never been taught these same levels mental agility when I was student struggling with examinations.

As a child, I was diagnosed as dyslexic. In addition, I was described as having an inability concentrate on and remember what my teachers were saying. As a result, I did not shine academicall and I left school at sixteen. What a shame that I was never shown the techniques described in th book. Even today, when we know comparatively so much more about the brain and the processes learning, children are not taught how to learn effectively. Why? I have to confess that the answer that question escapes me.

For the past few decades we have been concentrating on toning our bodies to make them appe beautiful; and we have been tuning our diets and lifestyles to keep ourselves physically healthy. Wi the advent of a new millennium, it now seems appropriate that we start nurturing, exercising a keeping healthy the command and control centre of our physical selves – the brain.

My hope is that by reading the text and experimenting with the exercises in this book you too wi discover the giant within you – and what a giant!

And, by the way, that forty-two-year-old went on to collect a sixth World Memory Championshi title.

Dominic O'Bri

a brief history of memory

from ancient times to the modern ag

We may regard memory as one of humankind's oldest arts. To our ancient ancestors, it was not ju
a useful aid to survival, but an integral part of daily life. In the absence of the printing press, memo
was the slate on which history was recorded. This was how we sorted information to help us mal
sense of the world. Reference devices were more primitive as well as thinner on the ground, so if fac
and figures were to be at the fingertips of the ancients, they had to be remembered – a job for intelle
and imagination. Throughout this early period of history, a good memory was a prerequisite f
success: epic poets, notably Homer, memorized their works long before they were ever written dow
and politicians, theologians and philosophers persuaded their audiences by delivering effective ar
convincing speeches, the memory cues for which were visualized colourfully in their heads. In th
chapter we look at how memory has been used and understood through the ages.

As children, and even as adults, some of the most wonderful stories we hear are those of our ov ancestry – tales that have travelled along the branches of our family tree like an army of determine ants. With each retelling, slight changes may be introduced – per haps an embellishment exaggeration to hold the wandering attention of a restless young listener, or an invention or two bridge an awkward gap in the known facts. This is how memories are polished to make them smooth and easier to pass on to others. Yet the basic body of information usually remains broadly intact. B listening to dozens of stories, we accumulate a knowledge of our past. We may look at old famil photographs, but without the context that memories – whether first- or second-hand – supply, suc physical records are merely visual ciphers.

If we go way back in time, before the invention of the personal organizer, before we had diari or even writing, we revisit an age when oral tradition was the only method of passing memories fro one generation to the next. Anything not recounted for the benefit of others would disappear from th collective consciousness, forgotten for ever. Hence, enormous importance was placed upon memor among the ancients – it was recognized that without memory and reminiscence the cultural heritag would be lost. There were a few libraries in ancient Athens, and there was also a limited book trad but these were no substitute for a wise man with a good memory.

We all have a vague image of the great epic poet Homer, whose feats of oral storytelling were n less heroic than the Greek and Trojan warriors whose stories he told. Homer relied on certain wel worn poetic formulae, improvised around a body of familiar material, and may even have used writin as an ancillary aid, at least for the Iliad, which consisted of 16,000 verses and would have taken fo or five long evenings to recite. Yet there is no doubt that a spectacular memory lay at the heart of h skills as a performer.

Homer’s great epics would have been somewhat fluid until in due course they were committed writing. By contrast, in the Vedic tradition of ancient India it was believed that any inaccuracies in th chanting of any of the sacred hymns of the Rigveda would cause an imbalance in the cosmos, with di consequences for humankind. In order to avoid such a catastrophe, Vedic priests carefully honed the memories so as never to make a mistake, and this has resulted in a highly unusual phenomenon: scripture, born out of oral tradition, that is believed to be very close to its original, spoken form.

Storytelling is a natural way to spend long winter nights in a village, which is one explanation, we pass into the Middle Ages, for the myths of northern Europe – extended tales of gods, giant dragons and strange transformations, whose origins are lost to us but certainly belong to an or tradition. The extreme nature of the subject matter, with its grotesque and magical episodes, made perfect for memorization – an obvious link between the surreal and the memorable that operates in th most effective memory systems today. After all, what could be more vivid than Ragnarok, the la great apocalyptic battle between gods and giants which in the mythology of the Norsemen marks th ending of the world? Once heard, such tales could scarcely be forgotten.

Mnemonic – the word we use for a device that aids the memory – is related to the nam Mnemosyne, the Greek goddess of memory, who was said to have known everything that is pas present and future. She was believed to be the basis of all life and creativity (an association derive from her role as the mother of the Nine Muses, who were the inspiration for all aspects of literatur science and the arts). Moreover, myth tells us that if a mortal were to drink from Lethe, the river o Death, all his or her memories would be lost for ever. From these mythic associations we can deduc that for the ancient Greeks memory was the fount of inspiration, and that its loss was synonymou with death – making it a faculty to be held in the highest esteem.

The so-called "father" of memory training was Simonides of Ceos, a Greek lyric poet who live during the mid 5th–6th centuries BCE. Having delivered a speech at a banquet, Simonides wa summoned with a message that two men were waiting outside to see him. As soon as Simonide emerged from the building, the structure collapsed, crushing everyone inside to death. (The two me never appeared, but were said to have been the twin gods Castor and Pollux, who saved Simonid because he had praised them in his speech.) The bodies were too damaged for the families to identif but by thinking back to where each guest had been seated during the banquet Simonides determine who was who.

In one stroke, Simonides had demonstrated his first p rin ciple of memory – that of locus, place. By attach ing images of what we need to remember to specific places, such as the rooms of house or the chairs around a dinner table, we impose a logical structure on a group of items that a otherwise unrelated, thus making them easier to recall. To remember any sequence of data (be the names, a shopping list or points in a speech), a practitioner of the locus technique would mentall retrace their steps through the place in which they imagined the information had been store (Interestingly, the English word "topic", meaning a subject or theme, is derived from the Greek topo a place.)

A great and beautiful invention is memory, always useful both for learning and for life.

DIALEXIS 400BCE

Although the Greek texts on memory are believed to have been lost long ago, the techniques the taught are preserved in Latin texts written between the 1st century BCE and the 1st century ce (sp.18). From these we find that the Greeks established and developed many guidelines to ensure th reliable operation of their locus method. For example, they devised the idea that the locus should b somewhere familiar to the memorizer, and that people and actions should be used as much as possib to make any visualizations deposited in the locus more memorable. They believed that the senses ha a strong role to play in memorization, especially sight. And the philosopher Aristotle is said to hav recognized the importance of association – making connections in the mind, which enable us to tak short, logical steps when storing and retrieving a memory. We will come across all these ideas later i this book – because each of them remains relevant to memory enhancement today.

The ancient Romans, like the Greeks before them, attributed prime importance to memory skill Citizens were greatly impressed by the memorization feats displayed by trained orators, and we quick to see its value in the political theatre of the times. They believed that memorization was fundamental component of rhetoric – without memorizing the structure of a speech, how could a orator make an impassioned plea or convincing argument?

Perhaps the most famous Roman to write about memory was the great politician and orat Marcus Cicero (106–43BCE), who helped to bring Greek teachings on memory to the Latin world in h work *De Oratore* ("On Rhetoric"). Quintilian (c.35–c.95CE), too, wrote an in fluential work called th *Institutio Oratoria* ("The Fundamentals of Rhetoric"), in which he applies the principles of the locu (see p.16) to a Roman villa. However, the most complete record of classical memory techniqu appears in the *Ad Herennium* (c.85BCE), which predates the Cicero and Quintilian texts – it is said have been written by a young (unnamed) boy. The techniques described in all three works draw large upon those of the Greeks, but the *Ad Herennium* makes a unique, important distinction about types memory, which both Cicero and Quintilian maintained: each of us has natural memory (our inna ability to memorize) but this can be improved through artificial memory – that is, memory technique According to Cicero, we all require our own individual levels of help from artificial memory. H himself had a good memory and could orate non-stop for three hours at a time, but he claimed th even his memory had to be supplemented by artifice.

During the Middle Ages a new perception emerged of the benefits of learning memory skills. Th scholastics (medieval academics) adapted classical memory techniques to teach religion and ethic The missionary Matteo Ricci used memory training as a vehicle to teach Christianity to the Chines Closer to home, the purpose of remembering the past was to inspire prudent conduct in the present ar future. In addition, imagery was seen as important in bringing to life the vices and virtues – many the preachers used vivid details during their sermons. These images were easy to lodge in the minds listeners, to keep the hope of heaven, the fear of hell and the lessons of the Church uppermost people’s minds.

Giulio Camillo’s memory theatre

During the 16th century the Italian philosopher Giulio Camillo achieved great fame for his memory theatres, the purpose of which were to awaken the mind to the memory of lost divinity. In stead of simply descri bing an imaginary theatre, he conceived, designed and built actual, wooden ones and exhibited them throughout Italy and France, where they stimulated a huge amount of interest.

Each theatre was large enough for two people to stand on its central stage, and the audience chambers were filled with ornate columns and statues of the gods, to represent “all that the mind can conceive and all that is hidden in the soul”. Camillo claimed that a speech worthy of Cicero could be memorized by mentally placing its key points on the statues and columns in the theatre.

During the Renaissance, with its resurgence of interest in classical traditions and its general spir of humanistic inquiry, there was a blossoming of interest in memory as well as the arts and scienc Memory techniques were no longer the sole province of religion – in fact, the pendulum had swun back, and some people even considered these methods to be the Devil’s own work. Memory theoris such as Guilio Camillo (1480–1544) and Giordano Bruno (1548–1600) adopted Plato’s theory th through memory human kind could transcend life and death and join with the divine. They believe that by using memory we could understand the mind of God and interpret the order of nature. Camil invented a series of elaborate “memory theatres” (see box, p.19), while Bruno stated that the key reaching the divine was in the organization of the mind and its locked memories. Bruno devised mar memory systems, finally completing a series of memory wheels. These wheels were seen microcosms of the heavens, and showed the orbits of stars and planets. On them he placed symbols the arts, languages and sciences, and used his sensory associations to lodge images and facts related these symbols in his mind. Then, while he observed the sky, the images he had associated with th heavens would be committed to memory and the brain would make order of the world. Branded heretic, Bruno was burned at the stake in 1600. In the ensuing centuries, as scientific endeavour ro to prominence, the art of memory no longer commanded such intense interest, yet the use of memo techniques never fully disappeared. In the eighteenth century, the Age of Reason, people sought

understand how the world worked. The emphasis was on discovering the harmonious system that la behind nature and human mind. The study of memory became part of a general investigation in biological science. People concentrated on discovering how the brain retained memories. Th scientific preoccupation meant that memory techniques involving creativity were largely rejected and the idea that a good memory was a mark of brilliance began to falter.

Children learning geography might be able to tell the names of every known tribe in Africa or every petty island in the Pacific, without knowing the name or course of the river which ran through their respective towns.

AN ENGLISH SCHOOL INSPECTOR'S REPORT 1846

In the nineteenth century, memory was seen not so much as a mysterious and spiritu phenomenon but as an empty vessel that could be filled by mechanical learning and repetition of fact This is the view behind the popular image of the Victorian schoolmaster, driving facts into his pupil minds by hammer blows of repetition. Rote learning became the basis of educational systems (and, some extent, still remains an important factor in schools today). This reflected an ethic of hard wor an unwillingness to believe in shortcuts, and, in the great age of scientific and industrial advance, profound suspicion of the imagination.

The twentieth century has seen a shift in the study of memory. Instead of looking for ways t improve our memories (for example, to build skills that will further our politicial ambitions scientific advances have taken us toward a better understanding of how memories are formed an stored in the brain. One of the most remarkable memory studies was undertaken by the Russia psychologist Alexander Luria between 1920 and 1950. His subject was a journalist name Shereshevsky, known simply as "S", who confounded his colleagues by never taking notes at editori meetings. He did not need to: he could remember every word, name, date and telephone number th he was told. As Luria tested S with increasingly complex data, all of which S could remember yea later, it transpired that S accomplished his amazing feats by translating everything he heard int strong mental images or sensual experiences. But S was not doing this purposely – he had a conditio called synesthesia, in which the boundaries of the senses sporadically become blurred, so that h might read the word "door" and experience a salty taste or see the colour red. The condition goes som way to proving how using the senses during memorization can create a series of imaginative pegs o which to hang pieces of information.

Since S's time, psychologists have studied many hundreds of other subjects, some with unusu memory defects or abilities, most with normal memory function and capacity. Their research ha yielded several theories on the way in which memory works. Although many aspects of memory physiology remain a mystery, we are increasingly aware of how well designed were the techniqu used by the ancient Greeks and Romans – how well adapted to the functioning of the human brain.

Recently, perhaps the most influential development in memory has occurred not in the huma mind but in machines. Our memory skills have become neglected as we increasingly rely upo external means of recording information – from the video to the personal organizer. We rate ou computers by the size of their "memory" and the speed with which they access it. We marvel at th versatility of the internet. Yet we neglect to realize the full potential that our own brains posses Memory skills are not taught in schools, yet memory is still tested in examinations. Most people d not know that memory can be extended by techniques anyone can master. We must look back to th ancients and revive their faith in the mind.

The Memory Chip

One distinction between human and computer memory is the relative ability of each to evaluate in for mation. Once a computer has stored data, so long as it is given the appropriate ret rieval cues, the computer will bring back that information perfectly in its most recently inputted form. In human memory, the information that we store and retrieve is subjective – it is susceptible to mood, opinion, up bringing, and a host of other social factors.

One other difference be tween com puter and hu man memory is our ability to remember layers of data in the same mental "document". In a computer's memory, of course, once data is overwritten, that information is lost for ever.

how memory work

In the 4th century BCE, the Greek philosopher Plato alleged that memories were etched on our brai like the scratches of a pointed stick in wax. Eventually, each etching would be worn away and replace by something new. The delightful simplicity of this theory belies the intensely intricate bra functions that enable us to memorize, retain and recall. Despite vigorous scientific research during th last hundred years, memory remains a mysterious, awe-inspiring phe nomenon – a wonderful maze which surprising self-discoveries lie in wait for us if we are prepared to stretch our minds to reali more of their potential. In this chapter we look at the basic physiology and psychology of memory the context of the brain as a whole. Of course, we do not need to know how electricity works to be ab to switch on a light. But learning something of the science awakens us to the mir aculous gift memory, for which we should all be thankful.

Memory has always been vital to our survival. Early nomadic humans needed to remember whe sources of game, nuts and berries were plentiful, and where they could find shelter in winter. Perha most importantly, they needed to be able to recognize faces to determine whether an approachi figure was a friend or foe. Our memory has evolved alongside other facets of our intelligence and t brain itself. Although the brain is an extremely complex structure, a simplified overview of some its regions and functions can provide a useful background to how our memory works.

The average adult brain weighs between 1,000 and 1,500 grams (2–3lb) and has the consisten of a soft-boiled egg. It serves as a command post and the processing centre for our prim ary physic and cognitive functions, including movement, speech, thought and perception. It is also t powerhouse of memory.

The lower part of the brain contains the brain stem, connecting the brain to the spinal cor Attached to the brain stem is the cerebellum, which controls the body's movements. Above the bra stem is the thalamus, containing the limbic system – thought to affect our motivation and emotio Just below the thalamus is the hypothalamus, a pea-sized region, which maintains the body temperature and chemical make-up; it also helps control sleep and the emotions. Collectively, t thalamus and the hypothalamus are known as the midbrain. The higher, more complex functions of t brain (the ones that make us uniquely human), take place in the upper region of the brain: t cerebrum. Memory, language and creativity are some of these higher functions.

The cerebral cortex, the layer of the brain that covers the cerebrum, is the most important regi as far as memory is concerned. The cortex is large and covered with furrows and ridges, which great increase its surface area so that it can hold a greater number of cells. Although the cortex compris only 25 per cent of the brain's total volume, it contains 75 per cent of the brain cells – known neurons. Primarily involved in integrating and processing sensory inform ation, the cortex contai two large regions called the frontal lobes, which are believed to help us store and recall memori The lobes are also associated with our emotions, personality and intelligence.

Altogether, the brain consists of some 10 billion neurons. Each neuron reaches out to one or mo other neurons using minute fibres known as axons and dendrites every time we undertake any sort mental activity. There are recognizable groups of neurons in the brain, but in principle a neuron ca communicate with any other brain cell to form a thought or memory, or to precipitate a course action. Every time we use our brain to make a memory, certain neurons transmit electrical impulses lightning speed along their axons. The impulses are picked up by the dendrites of other cells – formi a type of electrical circuitry in the brain.

Each neuron may have hundreds of dendrites. Between each dendrite and each fibre at the end the receiving cell's axon is a tiny gap, known as a synapse. When we use our brains, the electric impulses sent along the axons cause messenger chemicals, called neurotransmitters, to be released b the axon of one neuron and flow across the synapse to the dendrite of the adjacent neuron. Differe types of neurotransmitter carry different types of message – for example, serotonin acts as a natur painkiller and dopamine inhibits some of our movements. In addition, there are two types of synaps excitatory synapses, which stimulate an electrical impulse in the next neuron, and inhibitory synapse which prevent the electrical impulse from taking place. Together they control the unceasing activity the brain, which is firing billions of impulses at any given moment. The action of the synapses

regulating brain activity is largely responsible for how we encode our memories.

Membranes called meninges protect the brain. They are surrounded by the cerebrospinal flui which cushions the brain against the skull, and they also supply the brain with oxygen and nutrient Our brains need a constant supply of proteins, enzymes, salts and other molecules such as glucose ar calcium ions to manufacture the neurotransmitters, to enable the axons and dendrites to extend towa each other and for memories to be laid down. The brain's constant functioning means that it requires great deal of oxygen to keep the neurons alive. The brain claims only three per cent of the body weight, but it uses 20 per cent of our oxygen intake.

As for the brain, it is all mystery and memory and electricity.

RICHARD SELZER B.1928

EXERCISE ON

We recognize people in an instant, without having to think about the distinguishing features that mak such recognition possible. Birdwatchers identify birds from a distance in a similar way, by what the term "jizz" (adapted from General Impression by Shape and Size). Human "jizz" may comprise n only the obvious components of the face, but also more subtle characteristics, such as a walking with slight hunch, a flick of the head, the ways the hands hang from an undersized jacket. This exercise designed to show how the slightest clues clinch recognition, in a way that demonstrates th extraordinary power of the brain as a processing tool.

1. *As you walk around your local neighbourhood, look for people you know by sight. Scan around yo and look at quite distant figures. You are certain to pick out familiar figures – even if you are no actually acquainted with them.*

2. *Itemize the features that make such figures recognizable. What is the farthest distance over whic you can make a confident identification? You may be surprised at your powers of recognition – whic are dependent on memories stored unconsciously in the brain.*

The cerebrum or upper part of the brain – where memories and skills, such as language, are situate – is divided into two hemispheres, the left and right. The left brain controls the right side of the bod while the right brain controls the left side, although no-one can explain why this is so. A thick netwo of fibres, called the corpus callosum, bridges the gap between the halves, allowing them communicate with each other. If this bridge is destroyed, the subject's awareness of the body is totall divided – so, the left brain continues to process the experiences of the right side of the body, but th right brain has no knowledge of the actions, experiences or sensations of that side at all; and vi versa.

Scientists once believed that the left and right brains governed different mental functions. But more accurate view is that each hemisphere processes information in a different way. In most peopl the left brain is more specialized in "serial processing" – analyzing information in a linear fashio one piece after another. This makes it ideal for hearing and remembering speech, as well as processin numerical information, and logical problem-solving. The right brain excels at "parallel processing" synthesizing several pieces of information at one time into a coherent whole. It is better suited f recognizing and remembering pictures, physical features and emotions. Some say that the left side the brain is the analyst and the right side the aesthete. Epileptics who, in the 1960s, had operations sever the corpus callosum subsequently "forgot" how to write with their left hands and how to dra with their right (just as we would expect: each hand is controlled by the opposite hemisphere).

However, the distinction is not clear cut: the left brain can work as a parallel processor if it nee to, and the right brain is capable of linear analysis. Nevertheless, specialization of the tw hemispheres begins early in life and seems to be genetically pre-programmed. Measurements electrical activity in the brains of newborn babies show that the left brain responds to a click and th right to a flash of light. In addition, the level of logical/creative activity in each hemisphere vari between the genders. Women's brains tend to be more flexible than men's – if a woman's le hemisphere is damaged, she loses less of her verbal ability.

To use our brain, and therefore our memory, to maximum capacity, we need to engage both side of the brain in all we think and do. Most of the time we manage this naturally. For example, if we pla a musical instrument, our appreciation of the music takes place in our right brain but recollecting th tune and the actions required to play the instrument takes place in the left brain. Musicians who hav suffered injuries to their left hemisphere can still appreciate music, even though they have lost the ability to compose, play an instrument or sing in key.

In order to improve our memory, we need consciously to engage both hemispheres of the brain all stages of memorization and retrieval: when we take in new information; when we store it in o brain (thus creating a memory); and when we attempt the processes of recall necessary to bring th information back into our consciousness. All of the memory techniques in this book follow th principle that both logic and creativity must be employed if a memory is to make a lasting impressio upon our brain. Only then is the stage perfectly set for optimum recall.

The brain is continually active, even while we sleep. During the chemical processes that crea memories, as well as those that conduct our other mental functions, the neurons of the bra spontaneously fire impulses at varying intervals, to create charges of electrical activity that fluctua in voltage. The different frequencies of this electrical activity are known as brain waves.

Scientific investigation into the brain has determined that we produce different types of bra wave according to our various activities and thoughts. The beta rhythm is the normal rhythm of th brain when we are awake and active. The speed of the beta rhythm varies according to our levels activity and how stressed we feel (when we are stressed we emit a fast beta rhythm). When we a awake, but resting with our eyes closed, our brain waves flow in the alpha rhythm. Sometimes w produce two or more different brain-wave rhythms at the same time. For example, when we are in deep sleep we produce a mixture of theta rhythms (which are slower than alpha rhythms) and del rhythms (the slowest of all). During dreaming, or when we are drowsy (halfway between sleeping an waking), we produce only theta rhythms.

In order to optimize our ability to memorize, retain and recall information, we need to make th most of our brain when it is highly suggestive – that is, when it is emitting theta rhythms (preferab combined with alpha rhythms). But, since we are unable to memorize as we sleep, what does th mean in a practical sense? If we can find a way to encourage our brain to emit theta and alpha bra waves during consciousness, we will put ourselves in the correct “frame of mind” for optimu memorization. To do this, all we need to do is learn to relax. For many years, I have been practisin meditation, which has not only benefitted my emotional well-being, but has also enabled me to tra myself to slow down my brain waves so that I can memorize effectively. One of the easiest meditatio exercises is a focus on the breath – try it every day for ten minutes to get yourself used to ment relaxation. Close your eyes and draw air up through your nostrils and into your lungs, in one lon slow inhalation. Breathe out through your nose: mentally focus on the air flowing out through the rig nostril. Breathe in again, and on the outbreath focus on the left nostril. Alternate your focus during th exercise. When you come to memorize, try to recreate and tap into the calm (the theta waves) yo experience during meditation.

We use our memory constantly – each new thought or experience triggers a host of existing memo traces in the brain, whether or not we are consciously aware of them. Once awakened, they intera with the new stimulus, interpreting it, classifying it and often altering it – however subtly – to fit with what they "know" to be true. The sight of a red-capped fungus in the woods might conjure up th flavour of wild mushrooms, along with childhood warnings about the dangers of eating them. We ma even hear the voice of the parent who delivered the warning. At the same time, there will be a mass other, fleeting, memories. Part of the brain might even register the mushroom shape and evoke imag of atomic explosions. Part will respond to the redness, recalling blood and danger signs. Most of th memories will be so momentary that we will not notice them, but many of them will play a part governing our actions.

Since the nineteenth century scientists have speculated that the rich variety of our memori could be broken down into separate categories, and that each one might exist in a different region the brain. Although their attempts to find these regions have had limited success, a few of th classifications have survived. The most important of them distinguishes between sensory memor short-term memory (STM) and long-term memory (LTM).

Sensory memory has the shortest duration. The raw information gathered by our senses – sigh hearing, taste, smell and touch – flows into a sensory store, which is distributed between differe regions of the brain. Each sense has its own associated region, which is responsible for processing i input. For example, visual information is dealt with toward the rear of the cortex, while the prima hearing centre is in the temporal lobe (a part of the cortex at the side of the brain). There are also s called association areas in the brain, linking the sensory regions and allowing all the different inpu to be pulled together into a coherent whole.

The amount of information that can be held by the sensory store is practically unlimite although the sensory data generally lasts for only a fraction of a second before it is replaced by ne stimuli. An image in the visual cortex – called an icon – lasts long enough for a modern movi projected at 24 frames per second, to seem continuous (the image of each frame is still in the mi when the next is projected). But a silent movie, projected at its original speed of 18 frames per secon appears to flicker because the icon of each frame has already begun to fade before the next appear Auditory information seems to last longer than data from the other senses, lingering for sever seconds before it fades from our sensory memory.

The sensory store filters the signals from the senses and monitors them at an unconscious leve The vast majority of sensory information is almost immediately discarded, but a tiny percentage selected by the monitoring procedure because it meets certain criteria – for example, an image may b intensely coloured, or fast-moving, or an overheard sentence may contain a familiar name – and passed on to the short-term memory. This is not a simple one-step process. To the sensory memory, a apple is nothing more than a red or green, shiny, round solid. For us to perceive an apple, th information must first go to the long-term memory – also known as the permanent or referen memory – to be compared with the elements already there, in an effort to recognize what it is that w are seeing. Only after some sort of approximate match is found can the brain create a short-ter memory. The whole complicated sequence is almost instantaneous.

Short-term memory is also known as the active or working memory, because it depends on th