

# A simple guide to your *baby's brain*

by Cath Evans



*My First  
Five Years*

Our brains are amazing! They start to develop before we are born, change rapidly in the first few years of life and continue to change throughout our lives. The first part of this booklet gives a simple guide to your baby's brain and how it will change and grow in the next few years. The second part provides ideas you can use every day to support your baby's brain development – so, if you don't have much time, go straight to part two for some practical ideas!

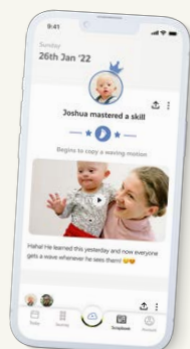


When we are watching our children develop new skills, it is often the things we can see them do that are most interesting to us. Often, the point at which they can demonstrate and use their skills and knowledge is when we feel we can say that they know or can do something. However, it is fascinating to think about all the activity that is happening in your baby's brain before they can demonstrate a skill. Sometimes, watching your baby or toddler explore a new object or repeat an action makes more sense when you think about what is happening in their brain.

## Understanding how we learn

Much of what we know about how babies and young children learn is based on studies in developmental psychology. Scientists observe children or set up situations that show when babies and children develop a particular understanding or skill. The area of cognitive neuroscience is growing, and this enables scientists to link the behaviours they see with what is happening in the brain, giving greater insight into how these skills develop.[1]

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## Your baby's brain

Your baby's brain started to develop before they were born. Scientists have found that babies in the womb respond to what is happening around them. When a baby is born, they recognise their mother's voice and other familiar sounds they have heard in the womb, for example, the theme music from their mother's favourite TV programme.[1]

Different areas of the brain mature at different times, with brain development being described as 'caudal to rostral'. Caudal comes from the Latin word caudum, which means tail, and rostral comes from the Latin word rostrum, which means beak or snout. In terms of brain development, this means the brain develops from the base upwards.[3]

The areas linked to survival, controlling things such as heartbeat, breathing and reflexes, are first to develop. The areas linked to the senses and movement are the next areas to develop, followed by those linked to language and position. The prefrontal cortex, which is concerned with, among other things, executive function skills including problem-solving, planning, reasoning, inhibition and attention, continues to develop into early adulthood.[1]

When your baby is born, they have most of the brain cells (neurons) that they will have in their lifetime. However, in the months and years after birth, your baby's brain will change considerably, as connections (synapses) will be made between neurons. Your baby is born with approximately 2500 synapses per neuron, by the age of three they will have approximately 15,000 synapses per neuron. The connections are made and strengthened as a result of experiences, with repetition leading to stronger connections and links between parts of the brain.[2]



The development of your baby's brain involves connections being made between neurons. These connections are formed by electrical signals which travel between neurons via synapses, which are tiny gaps between neurons. Signals move across a synapse either by electrical activity or chemicals known as neurotransmitters.



The connections your baby's brain makes and maintains depend on their experiences; events that are repeated will make stronger connections. When you chat with your baby or give them time looking at, touching and mouthing a new toy or object, they are building and strengthening connections in their brain. Your baby will learn about the world through their senses and by linking information that they receive from their senses to develop their understanding of the world around them. When you give them different experiences, and time to move and to explore objects, you are helping them to make these connections as they link information together.

## Areas of the brain

This is a simple guide to the brain, so these elements are simplified. While different areas of the brain might be particularly important in carrying out some functions, areas of the brain work together. For many functions, there will be several parts of the brain involved and we have simplified this aspect.

You can also see the hand model for understanding the brain, which was developed by Professor of Psychiatry at the UCLA School of Medicine, Daniel Siegel, in our blog: **[Your child is really just a cave person - but cuter!](#)**

There are different ways to explain the brain's structure. We will describe the areas that make up the subcortex and those that make up the cortex.

## The subcortical brain

The subcortex is beneath the cortex and is linked to what are often described as 'primitive functions', such as response to threat. Areas of the brain interact with each other all the time, so responses usually involve activity in several areas of the brain.

## Brain stem- medulla, pons

The brain stem is at the base of the brain and is the area of the brain that is most fully developed at birth. This area controls reflexes and actions linked to survival, such as breathing and heartrate. The brain stem also passes information between the brain and spinal cord.

## Cerebellum

The cerebellum is sometimes known as the little brain. This area is involved in several functions, including language use and decision-making, but is usually linked to its role in planning and controlling movement.[4]

## Thalamus

The thalamus is above the brain stem and has a role in receiving and processing signals from your senses. The thalamus receives and processes signals and then passes these to the appropriate area of the brain.

## Hypothalamus

The hypothalamus is below the thalamus and is involved in the regulation of things such as eating and sleeping, partly through regulating hormones released from the pituitary gland.

## Limbic system

The limbic system refers to the areas of the brain around the thalamus. There is some discussion about which areas are included in this system but, it is thought to include the **amygdala, insula, hippocampus and cingulate cortex**. This area of the brain is associated with emotions. The limbic system works in what is described as a 'stimulus-response' level, so the response to fear might be fight, flight, or freeze, and the response to feeling anger might be to hit out in some way, by hitting, kicking, or shouting, for example.[3]



Some scientists think that the ability to regulate emotions and respond in a more controlled way to experiences is linked to the development of the prefrontal cortex. So, the tendency that young children have to respond immediately to their emotions is linked to their immature prefrontal cortex.[2]

However, other scientists argue that emotions are more complex than this idea might suggest. There is agreement that the amygdala might trigger a response to a stimulus but a suggestion that our feelings or emotions are the result of cognitive processing. We interpret information received from our surroundings and our emotions as a result of this cognitive interpretation. So, emotions are a result of our thinking, rather than simply an instinctive response. This means our emotions are individual, and our understanding of our emotions develops as a result of our experiences.[5]

It is important to note that this is a simplified guide to your baby's brain, and that there is research happening all the time which is improving our understanding of how our brains work.

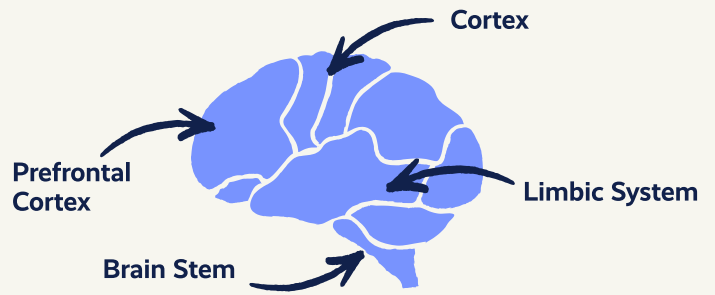
**However, the discussion about the limbic system and development of emotion, while interesting, wouldn't change your interactions with your baby or child. Whichever understanding of emotions is used, your baby or child will need your support to develop their understanding of their emotions, and their ability to regulate their emotions and responses to events.**

## Cortex

When you imagine a brain, the image that comes to mind is probably the cerebral cortex. The cortex fits over the rest of the brain and has the folded surface that we often picture when thinking of the brain.

The cerebral cortex is divided into two cerebral hemispheres, and these hemispheres are divided into four lobes, described in more detail in the next section. The hemispheres are connected by the corpus callosum.

The left and right hemisphere are often associated with particular functions, and you might have heard people being described as 'left-brained' or 'right-brained' due to characteristics people believe are linked to using one side of the brain more than the other. It is now understood that our brains work in a very interconnected way, so while a particular area of the brain might have a key role in a function, carrying out the function is likely to involve other areas of the brain as well.



In this guide, I am going to focus on the four temporal lobes rather than the cerebral hemispheres. The brain has four lobes, the temporal, frontal, occipital and parietal lobes. The lobes are full of folds, which bring cells closely together under and over each other.

## Frontal lobe

The frontal lobe is the largest lobe of the brain. If you place your hand on your forehead with your fingers stretched towards the back of your head, your hand will be over your frontal lobe. This part of the brain is involved in more complex thinking. The front part of this lobe is the prefrontal cortex, which is important in executive functions such as memory, inhibition control, self-regulation and planning.[3]

## Parietal lobe

The parietal lobe is towards the centre of your head. This area is significant in processing information from your senses and in controlling some aspects of movement.[3]

## Temporal lobe

The temporal lobes are around the level of your ears. You have one of these on each side of your head. The temporal lobe is involved in processing sounds and most people process speech in the left temporal lobe. The temporal lobe also links with the hippocampus in the process of forming long-term memories.[3]

## Occipital lobe

This is towards the back of your head and, as you might have worked out from its name, is involved in processing visual information.[3]

## The development of the cortex

The cortex is the last area of the brain to fully develop. It develops unevenly and continues to develop into adulthood. The areas linked with sensory information and movement develop quite quickly but areas involved with more complex functions, such as the parietal, temporal and frontal lobes, continue to develop into adulthood.[4]

While you might see areas of the brain described as being used for a particular function, scientists agree that the brain is much more interconnected than this might suggest. This leads us to the next section of the booklet – what exactly are we talking about when we talk about connections in the brain?

## What do we mean by making connections in the brain?

### Brain Architecture

Forming and strengthening the pathways in the brain builds what Harvard's Centre on the Developing Child describes as your baby's 'brain architecture'. This brain architecture consists of billions of connections between individual neurons across the brain, and although your child's early years are a period of rapid development, these connections will continue to form throughout their lives. The connections made in your baby's brain will form the foundation for the development of connections throughout their life.[6]



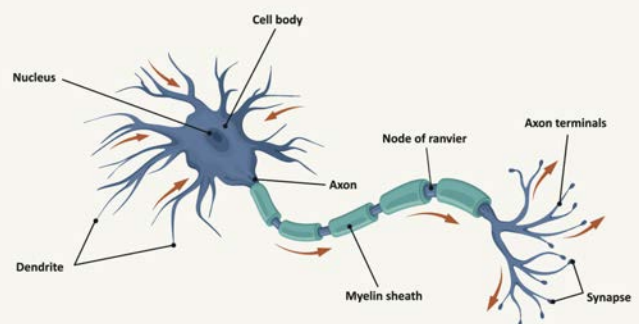
## Neurons, synapses and myelination

The brain has several types of cells, but usually when we talk about brain cells we are talking about neurons. Neurons are either active or not. Connections between neurons involve electrical impulses and chemicals that carry signals between neurons (neurotransmitters).

Neurons form pathways as connections are made and strengthened, and some scientists suggest that when a memory is recalled, the cells on the pathway linked to that memory become active.

## The structure of a neuron

Neurons have three parts: cell body, dendrites and axons. Dendrites bring information to the cell and axons take information away towards small gaps (synapses) with neighbouring neurons.



## Synapses

Synapses are small gaps between neurons. The word synapse is from the Greek word for 'to clasp'.

Synapses are where signals between cells are transmitted. These can be transmitted as electrical signals or by chemicals known as neurotransmitters, for example, dopamine or serotonin.[4]

## Axon

The axon is covered by a white fatty substance called myelin, which helps signals pass efficiently between neurons, and prevents the signals passing between different neurons from interfering with each other.

The process by which this myelin sheath forms is known as myelination. This process is rapid in your baby's first two years and continues into adulthood.

## Myelination

Myelination happens as a result of experiences and is part of what we mean when we talk about making connections in your baby's brain. When your baby experiences something new, new pathways in their brain are active. As these experiences are repeated, the pathways are active again and myelination occurs, strengthening that pathway so signals move between neurons efficiently.

## Synaptic pruning

As your baby develops, some of the connections in their brain which are not used frequently will be lost in a process known as synaptic pruning. This might sound concerning, but synaptic pruning is an important part of our brain's development.

Pruning allows frequently used pathways to become more efficient and results in a brain that is perfectly developed for our individual needs.

## What helps to build your baby's brain?

As you can see from the first section of this booklet, the human brain is an amazing and complex structure. It helps us adapt to the world around us, and connections continue to be made in our brains throughout our lives. Despite this complexity, supporting your baby and child's brain to develop is quite simple!

In the next section, we will consider five simple ways that you can help them build and strengthen the connections in their brain. You will see we talk about your baby, but these ideas apply throughout their first five years and beyond!

## Responding and taking turns

One of the main ways in which you will help your baby to make connections in their brain is by responding to them. At first, these responses might be picking them up or feeding them when they cry, or gently rocking or stroking them to provide comfort. Then you might notice them moving more or becoming still when they hear a sound or see something new. When you respond to this by commenting, or with a touch or smile, you will help them to make connections in their brain.



As they grow and develop, your baby will have more ways to initiate and respond to your interaction. They will use movements, smiles and noises to take a turn as you play and chat with them. As they develop their communication skills, they will use gestures and words to share their interests and continuing to respond to these will support them to learn and develop.

Remember your baby will also show you when they are ready to stop interacting. They might turn away or not respond when it's their turn. Responding when they are ready to stop is important too.

Being responsive to your baby is important but if you cannot respond straight away every time that is ok – they need you to be responsive most of the time, not all the time!

Read more about serve and return interactions in our blog: [\*\*Serve and return! Playing with your baby\*\*](#)

## Moving

One of the first areas of your baby's brain to develop is the area linked with movement and the senses.

Making sure your baby has time to move and spends time in various positions will support them to make connections in their brain.



Think about giving your baby time on their tummy, back and held upright in your arms. These different positions give them time to move in different ways. If you have time to, giving them a bit of nappy-free time to have an extra wriggle is great for supporting their brain development too!

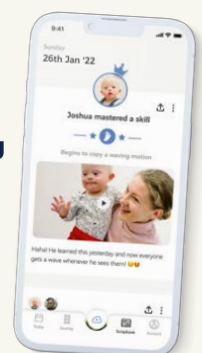


As your baby's control and strength develop, movement will continue to be important in supporting their brain development. Moving in different ways provides different sensory experiences and can enable your baby to explore objects in new ways, and so help to make connections in their brain.

When they can walk, having big spaces and varied surfaces to walk on can support the development of their physical skills, which will continue to support the development of their brain.

You can read a little more about supporting physical skills outside in our two blogs: [\*\*Leaves, sticks, fingers and toes - Developing fine motor skills in the woods\*\*](#)

**Our app will guide you through your child's physical development journey and how it links to what is happening in their brain. Download it now!**





## Novelty and repetition

This might seem a strange heading as it describes opposites, but both new experiences and repeating familiar ones are important in brain development. New experiences and objects will create new pathways in the brain and repetition is important as it strengthens existing connections.



Repetition in terms of your daily routine can also be comforting for your baby, and as they develop, having a basic sequence of how you do things will provide the basis for a more definite routine. For example, if you can establish a 'bath, bottle (feed), bed' routine, even if 'bed' is a feed and cuddle, this will help you to establish a bedtime routine when your baby is older.

Repetition also helps your baby to refine and control movements as they master new skills. They will use repetition to learn about objects and as they learn words and begin to speak. You might find that your baby begins to have a favourite story that you repeat frequently, as they always choose it! Think about choosing stories you enjoy, as you might find you read their favourites a lot!



Novelty is quite easy when your baby first arrives – the entire world is a new experience for them! But as they grow and develop, think about providing a mixture of new and familiar experiences, toys and objects. This could be as simple as going to a different park or going out for a walk and choosing a slightly different route. Think about the sights, smells and sensations your baby experiences, and how you can give them new experiences as well as chances to repeat familiar ones.

You can read more about using a hill to provide opportunities for sensory development in our blog - [\*\*this could provide some extra ideas too!\*\*](#)

## Comforting and supporting

While your baby's brain is immature, they will need your support to manage their emotions, from being comforted and having their needs met when they cry to supporting them when they feel angry or frustrated.

You can support your baby to understand their emotions by talking to them about how you think they are feeling. Making what scientists describe as 'mind-minded' comments help your baby to make connections between areas of the brain. These connections will, in the future, help them to think about their responses and to regulate their emotions.



## Playing and pretending

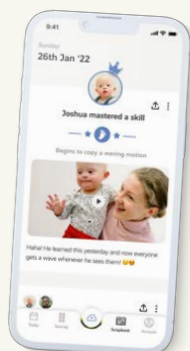
Playing with your baby is brilliant for building their brain, partly because it gives lots of opportunities for 'serve and return' interactions (so, for you to respond to the things that interest them), but also, because play can be a wonderful way to recreate experiences and strengthen connections in their brain.

Remember when we talk about regulating emotions, most of us think about emotions such as feeling sad, angry, or frustrated. However, your baby will also need support to regulate emotions such as excitement and happiness. Your baby might find it difficult to recognise when they need a little time to calm down, and this can lead to them becoming overwhelmed by emotions that we might think of as positive.

Your support and encouragement can also be important when your child is experiencing something new or trying something that they find difficult. This might be simply by giving them a word of encouragement, allowing them to stay close to you and watch when somewhere new, or giving a smile as they keep trying.

You can read more about supporting your toddler's emotions in our blog about tantrums: **"I want the other one!" What you need to know about tantrums**

**Our app can help you understand how to support all of your child's feelings and emotions in the moment. Download from the app store!**



Your baby's early play will focus on movements and on you and other people. As their physical skills develop, they will begin to play with and explore objects.

When your baby starts to pretend, there will be even more opportunities for brain development. Pretending involves executive functions, as to pretend we need to inhibit information and use our working memory. Pretend play is also a wonderful vehicle for exploring ideas and learning about people and the world.

You can read more about pretend play and executive functions in our blog: **Who's on the phone? Pretend play and executive functioning.**

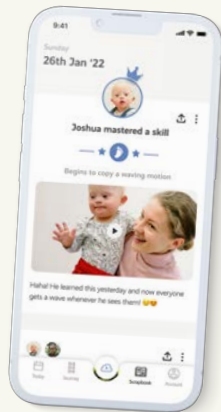
## And finally

Healthy brains and healthy bodies are closely linked, so think about your child's sleep, diet and physical activity too. A healthy diet, enough sleep and exercise will also help your child's brain to develop.



Our app will support you to notice and support your baby's development. We have the skills that show the small steps that lead to the big steps in their learning and development, activity ideas and lots more information about your baby and their development.

**We have content from experts as well as our experienced team of content writers and a supportive community of other My First Five Years parents, download the app here:**



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