Understanding Neuroscience and Self-Regulation in Early Years

Level 2

Hallmark Education

NCFE CACHE ENDORSED

This course combines two important and interrelated subjects within the field of child development – neuroscience and self-regulation.

'Neuroscience' may be an unfamiliar term to you, but this exciting field of research is highly significant to anyone who supports or works with babies or young children. This course is designed to give you an introduction to the subject, and to share with you some of the remarkable insights it has given us in terms of how the infant brain develops, and how this is affected by a range of external influences, not least adults and the care environment.

This course also explores the important subject of emotional and behavioural self-regulation. The findings from neuroscience reveal why many young children find it difficult to manage powerful emotions such as anger, sadness, fear and disappointment, and how these moments of 'dysregulation' often direct their behaviour. As you will learn, adults play a vital role in helping children to acquire self-regulation skills and to return to calm when faced with stressful experiences.

Sadly, many children who struggle to self-regulate are negatively labelled as 'prone to temper tantrums', 'naughty', 'defiant', and so on, which can have negative consequences for their self-esteem, academic progress and future prospects. This course encourages parents/primary carers and educators alike to look at the meanings behind behaviour and to appreciate how things like stress and a range of adverse childhood experiences may be influencing the child's emotional responses and behaviour.

As well as explaining the theory behind the science, this course will provide you with practical advice in terms of how to promote healthy brain development in the critical first seven years of life, and how to support children to learn key self-regulation skills.

This course features quite a few technical terms. We have included a list of key words and what they mean in the **Glossary of Terms** at the end of this workbook. You may find it useful to refer to these when you are working through the course.

Aims

On completion of this course, you should:

- Be able to explain how the brain develops both during pregnancy, and from birth to seven years.
- Understand the factors that influence the healthy development of the infant brain.
- Be able to define the terms 'self-regulation' and 'co-regulation', and explain how adults can nurture children to achieve self-regulation.
- Be able to identify different types and causes of stress and how these can impact on children.
- Understand adverse childhood experiences and how these can influence long-term development and well-being.
- Understand the differences between behaviourist approaches and relationship-based approaches to behaviour management.
- Appreciate how emotion coaching can support practice in early years settings.

Course content

There are two units in this course as follows:

Unit 1: Understanding neuroscience in early years
Unit 2: Understanding self-regulation and how to nurture this in children from birth to seven years

Assessment

Each unit in this course is split into a number of sections. Within each section there are learning **activities** for you to complete. These are intended to help you reflect upon particular issues and your own practice. These are not formally assessed and are intended to aid your learning and understanding.

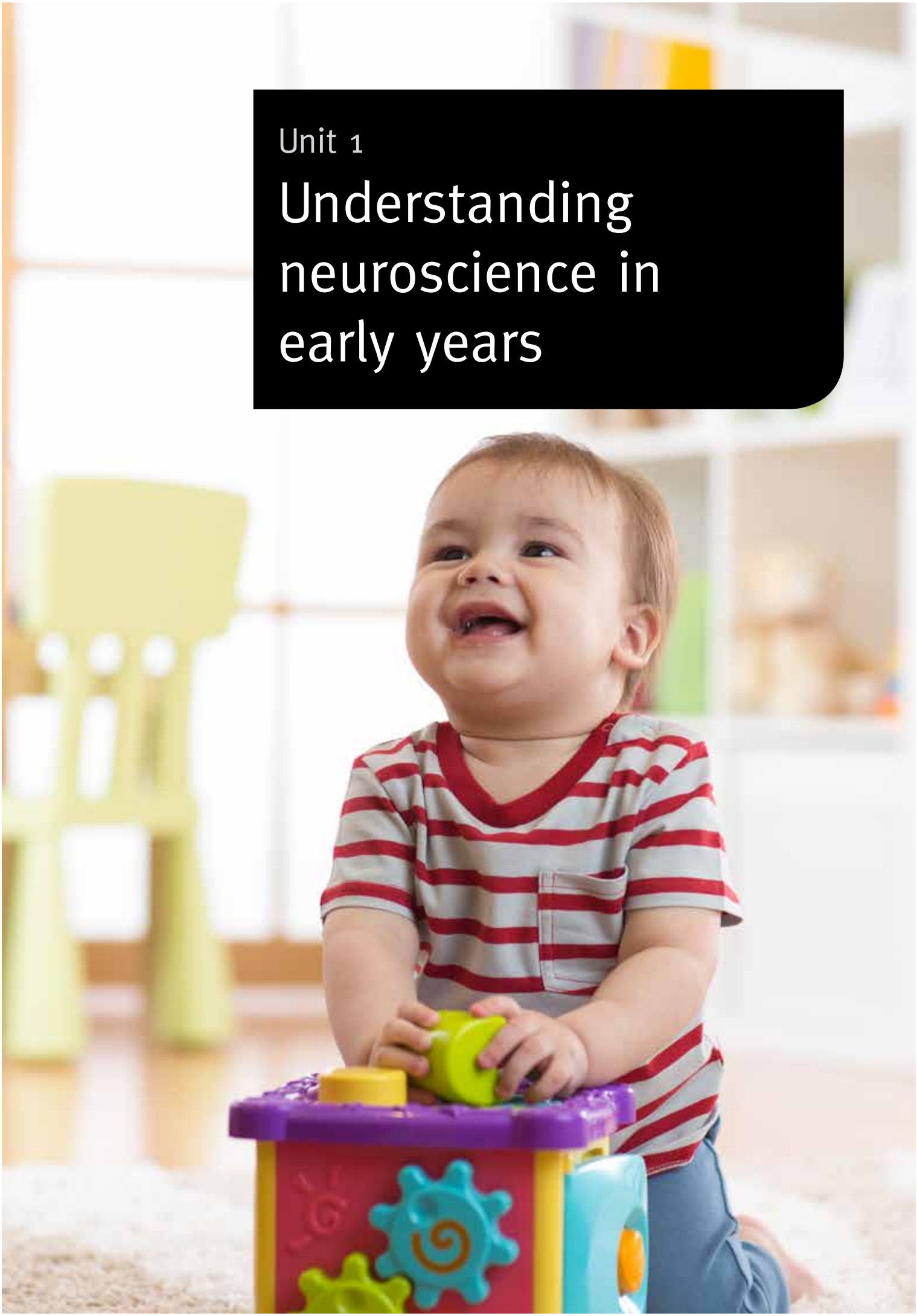
At the end of each section you will be asked to complete the **assessment** questions for that section. These questions can be found in a separate assessment booklet. These are formally assessed and you must complete these to the required standard to be awarded the qualification.

When you have completed all the assessment questions for this course, you should submit them to your learning provider for marking and feedback.

Good luck with your studies!

Unit 1

Understanding neuroscience in early years



Neuroscience can seem like an intimidating subject, and you may wonder why you need to know technical information about the brain if you support or work with young children. But neuroscience has given us remarkable new insights into how a child's brain develops – not only after it is born, but also before birth whilst the foetus is developing in the womb. The findings are hugely important to both primary carers and educators, but most of all to the children in our care.

This first unit will explain in more detail why neuroscience is so relevant to early years education and care, and provide you with a basic introduction to the subject. You will explore some of the key parts of our amazing brain and nervous system, and find out about the factors that influence early brain development.

Exciting advances in brain imaging techniques mean we can now see how external influences affect brain development. Some have a positive impact, for example, human warmth and affection, and a safe and nurturing care environment. Others, such as poor attachments, chronic ill treatment and lack of high-quality care and education, can have a damaging effect on a child's developing brain. All these factors can affect children's behaviour, learning, educational outcomes and general happiness. Neuroscience enables us to gain a better understanding of their impact.

Content

This unit has three sections:

Section 1
The neuroscience of early brain development

In this section you will learn about:

- What neuroscience means
- Why neuroscience is important in early years provision
- How we are getting to know more about the brain
- The nervous system
- How a baby's brain develops and grows during pregnancy
- Brain development from birth to seven years.

What is neuroscience?

Let us begin by looking at what the term 'neuroscience' means. 'Neuro' comes from the Greek word for nerve or nerves. Therefore, in straightforward terms, **neuroscience is the scientific study of the nervous system**. This includes how the nervous system develops, its structure and what it does.

Did you know?

The human nervous system includes:

- ✔ The brain (and its 86 billion brain cells or 'neurons')
- ✔ The spinal cord
- ✔ A complex network of nerve fibres that connect the brain to all other parts of the body

These incredible components enable us – amongst many other things – to breathe, think, feel pain and emotions, speak, move our body and make sense of the world around us.

Neuroscience has numerous branches or areas of speciality, and this course draws upon the findings of a number of these. For example, **affective neuroscience** studies the parts of the brain that are responsible for emotions. **Developmental neuroscience** looks at the processes that shape the development of the brain. **Behavioural neuroscience** studies the biological basis of our behaviour, focusing on how the brain affects our actions. And **cognitive neuroscience** is concerned with better understanding how we think, learn and understand.

Other branches of neuroscience are also helping us to better understand different neurological conditions and disorders, such as dementia and brain injury. In time, it is hoped that new treatments will emerge for conditions such as these as a result of the insights that neuroscience can provide.

Why neuroscience is important in early years provision

> **"We can now start to identify the effects that early experiences have on the developing architecture of the brain – positively and negatively. So, factors such as nutrition, health, sleep, opportunities to play, affectionate and responsive relationships and, conversely, the presence of continued stress, domestic violence and chronic maltreatment are now being interpreted from brain imaging studies."**
>
> (Conkbayir, 2021)

The good news is that early years practitioners, teachers, parents, and so on, can help children to cope better with stressful situations by teaching them how to develop their 'rest and digest' response. In other words, by stimulating the parasympathetic nervous system.

For example, if a child can learn to slow down their breathing when they feel stressed, angry or anxious, the parasympathetic system 'tells' the brain that they are not in any danger. As a result, the child's heart rate slows down, and they are much less likely to enter a state of 'fight or flight'. You will look at calming techniques that you can teach children, such as deep breathing exercises, taking time out and emotion coaching, later in the course.

Key point

Neuroscience has helped us to spot the signs that a child's stress response has been activated, and shows how certain calming strategies can trigger a relaxation response.

Soothing children when they are stressed and upset activates their parasympathetic nervous system.

Activity 2

If you work with children, it is important that you can recognise the signs that a child is becoming distressed and why certain strategies can help to counteract these effects. Based upon what you have learned so far about the sympathetic and parasympathetic systems, place these signs and indicators into the correct column below.

Heart beats in slow, rhythmic pattern

Heart beats fast

Blood pressure lowers

Breathing is fast and shallow

Pupils of the eyes expand

Breathing is full and slow

Pupils of the eyes shrink (constrict)

Gut is active (helping you to digest and absorb the nutrients from food)

Gut becomes sensitive (making it difficult to digest)

Blood pressure increases

Increases saliva production

Blood rushes to your skeletal muscles and away from your brain (making it hard to think clearly)

Increased blood flow to gut, lungs and brain

Stress hormones rush through the body (making you feel anxious)

Inhibits saliva production (causing the mouth to feel dry and the throat to feel tight)

Increases energy

Restricts production of stress hormones (e.g. adrenaline and cortisol)

Conserves energy

SYMPATHETIC NERVOUS SYSTEM	PARASYMPATHETIC NERVOUS SYSTEM

You can check your answers at the end of this workbook.

The process of early brain development from birth to seven years

Although a baby's brain looks like that of an adult, it is far from being fully developed. **From birth to seven years in particular the brain continues to grow, and vital new connections and pathways are being made all the time**.

Growth in brain size

At birth, the average baby's brain is about a quarter of the size of the average adult brain. Incredibly, it doubles in size in the first year of life. From there, the brain continues to grow rapidly. **By the age of three it is about 80 per cent of an adult brain, and by five years old it is 90 per cent – nearly fully grown**.

Growth in the number of connections between brain cells

Although most of the brain cells (neurons) we need as an adult are formed in the womb, the connections that enable these cells to communicate with each other are not. These connections are called **synapses** and they are largely created in the first three years of life. In fact, **at least one million synapses are made every second during the first three years – more than at any other time in our lives**. As these connections link up different parts of the brain, they effectively enable us to move, think, communicate and do just about everything else!

As you will explore in more detail in the next section, the brain actually creates many more synaptic connections than it needs – at age two or three, the brain has up to twice as many synapses as it will have in adulthood. These **surplus connections are gradually eliminated throughout early childhood** and adolescence, as the brain makes space for new connections and those it uses regularly. This process is known as **'blooming and pruning'**.

Real-life case study: The Romanian orphanages and their aftermath – the effects of deprivation and neglect on the social brain

In 1989, the Romanian dictator Nicolae Ceausescu was overthrown. During his time in power, abortions and contraception had been banned. This led to large numbers of babies and infants being abandoned in the country's orphanages, most of whom lived in squalid and inhumane conditions. It is estimated that there were over 100,000 children in these orphanages in 1989.

In these institutions, food was scarce, and heat and electricity were often intermittent. In fact, these places were so dark that many of the children never developed full eyesight. Babies were left in their cots for most of the time and fed in a way that resembled an assembly-line. There was little if any eye contact from the staff. Older children were often chained to their beds, and many would spend their day naked or half-naked (as staff did not help or encourage them to dress). Often, they would be left to sit in their own faeces and urine. The babies and children were deprived of any affectionate human interactions and relationships. Many of the children had been abused physically, emotionally and sexually. Staff who did show compassion towards the children were considered weak and some lost their jobs as a result.

'Outsiders' who entered the orphanages from the first time were often struck by the silence. As one researcher put it, 'The most remarkable thing about the infant room was how quiet it was, probably because the infants had learned that their cries were not responded to.'

After the orphanages were discovered, researchers, including some neuroscientists, began studying the children and followed their development over the ensuing years. They wanted to understand how deprivation and neglect alters a child's brain, and how this in turn can affect their behaviour (and whether this damage can be undone).

One study (Nelson et al., 2014) found that the institutionalised children had smaller brains, with a lower volume of both grey matter (which is made primarily of the cell bodies of neurons) and white matter (which is mainly the nerve fibres that transmit signals between neurons). **Quite simply, prolonged deprivation and neglect had significantly affected brain growth.**

In another study of 6,000 Romanian orphans who were adopted by American families (Bruce et al., 2013), researchers also identified a number of common changes in brain structure, namely a reduction in brain volume and the **underdevelopment of the prefrontal cortex** (the area of the brain responsible for interpreting, reasoning and decision-making). This meant that some of the children had difficulties with processing information, flexible thinking and working memory. They also found it difficult to understand other people's mental states and to express appropriate emotion themselves. These difficulties were often manifested in a child's behaviour, and **many struggled to form and sustain relationships, and to successfully regulate their emotions**. Many also suffered with high levels of anxiety.

However, the studies also revealed the **tremendous plasticity of the brain** – its ability to change and adapt when exposed to a more nurturing environment. Among the children who were adopted by supportive families in Romania or internationally, most who were under the age of two when adopted or who had spent less than six months in an orphanage showed remarkable signs of recovery by the age of eight. These children showed improvements in language, IQ and social-emotional functioning. They were able to form secure attachment relationships with their caregivers and made dramatic gains in their ability to express emotions.

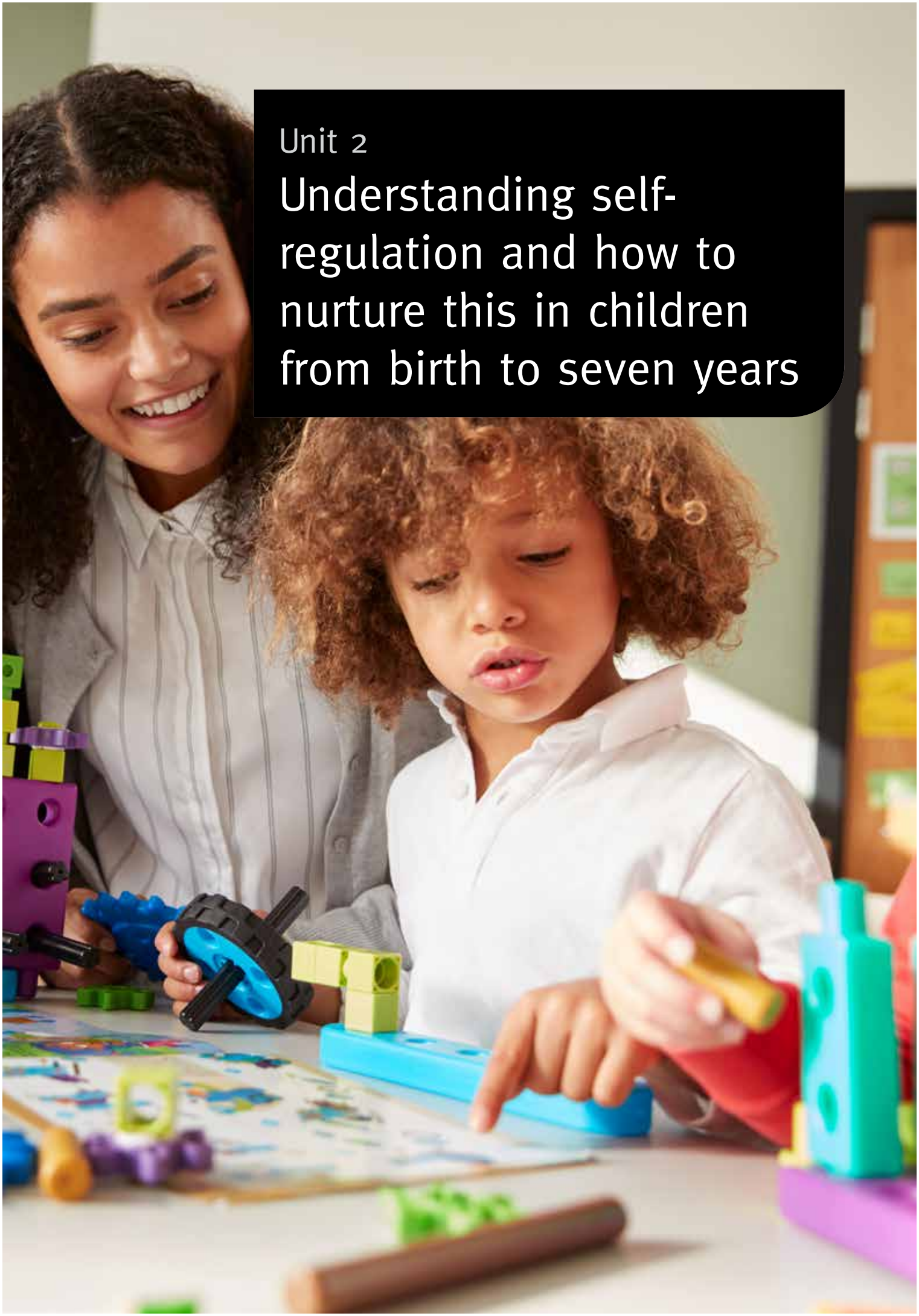
Unfortunately, children who had spent longer periods in the orphanages experienced higher rates of social, emotional and cognitive difficulties and these have endured throughout their lives.

The importance of relationships in language development

Another area in which relationships can positively affect the development of the social brain is the acquisition of language – a child's ability to understand language and communicate verbally. Numerous studies have shown that **language-rich interactions** between an adult and a child accelerate the child's ability to express themselves verbally and to understand what others are trying to convey to them through words.

Parents and the home learning environment are very important here. Indeed, studies using brain imaging techniques have shown greater brain activity in the language regions of children who engage in back-and-forth conversations with their parents at home.

Studies have also found that the number of different words that adults use is less important in developing speaking skills. More important is **the amount of back-and-forth conversation between children and adults**. This is also known as **'serve-and-return interaction'** and it is critical to both language development and the ability to understand non-verbal means of communication.



Unit 2

Understanding self-regulation and how to nurture this in children from birth to seven years

Self-regulation is the ability to regulate (manage) our thoughts, feelings and behaviour. Young children have limited capacity to self-regulate and it takes time for them to learn these skills. This process is important, as self-regulation helps children to control those 'big', potentially overwhelming emotions, such as anger, sadness and fear, and to manage their subsequent behaviour.

This unit explores the reasons why many children find it difficult to manage strong emotions and stressful experiences, and how this is often manifested in behaviour that others may find challenging. You will also look at how a child's background and a range of adverse childhood experiences (ACEs) can influence their behaviour.

The adults in a child's life play a vital role in helping children to acquire self-regulation skills and to return to calm when faced with stressful experiences. Therefore, this unit examines the role of something called 'co-regulation' (the supportive process between caring adults and children that helps the child to learn how to self-regulate).

As caring adults, how should we respond when a child is emotionally dysregulated and perhaps behaves in ways that challenge us? The final section of this unit explores different approaches to behaviour management and how a relationship-based approach called 'emotion coaching' has been shown to support and improve practice in early years settings.

Content

This unit has five sections:

Section 1: The role of the limbic system
Section 2: Self-regulation
Section 3: The role of co-regulation
Section 4: How stress and adverse childhood experiences can impact on children
Section 5: Different approaches to behaviour management

Section 1
The role of the limbic system

In this section you will learn about:

- What is the limbic system?
- The main components of the limbic system
- The upstairs and downstairs brain
- The stress response system
- How to calm a child who is stressed

What is the limbic system?

We're now going to delve deeper into the brain and its structure, to find out why many children find it difficult to regulate, or manage, their emotions and behaviour. As you learned in Unit 1, situated deep inside the brain, below the cerebrum, is the 'limbic system'.

The limbic system is a collection of structures that are heavily involved in triggering our emotional and behavioural responses. Powerful emotions such as anger, sadness and joy are all activated in this region of the brain. It also plays an important role in regulating our mood and levels of motivation. For these reasons, the limbic system is sometimes called the **'emotional brain'**.

Did you know?

Scientists believe that the human stress response has evolved over thousands of years as humans learned to survive and adapt to the harsh realities of their environments. In prehistoric times, it would have helped our ancestors to escape from danger, such as being chased by a woolly mammoth! It gave us the alertness and energy to either fight our foe, or take flight and remove ourselves from danger.

Though the woolly mammoths of our ancestors' time are long gone, the fight-or-flight response is still very much part of our instinctive behaviour. Sometimes, this is a good thing. In emergency situations, it can save our life. For example, it can give us extra strength to defend ourselves, or spur us to slam on the car brakes to avoid an accident.

However, **being subjected to too much stress or prolonged periods of stress can mean that we become stuck in this fight-or-flight mode**. In other words, even though there may be no immediate danger, we remain in what scientists call a **hyper-aroused** and **hyper-vigilant** state. This also applies to children. If they are exposed to excessive or prolonged levels of stress, their **brains can become 'primed' or 'hard wired' for danger**. This can make them anxious, fearful and suspicious of others. It can also make them react in ways that seem out of proportion to the reality of the situation.

You will look at different types of stress, and how they can affect the mind and body of a child, later in the unit.

How to calm a child who is stressed

In Unit 1, we looked at the sympathetic and parasympathetic nervous systems. As you may remember, the **sympathetic nervous system** controls our stress response. We now know from neuroscientific research that, once activated, the sympathetic nervous system sends warning messages down our spinal cord and into the nerve fibres that control our glands and organs, preparing us to take emergency action. When a child is feeling stressed or dysregulated, it means that their sympathetic nervous system is in charge.

The **parasympathetic nervous system** works in the opposite way. When this is activated, it acts to calm the mind and body. It does this by stimulating the activity of soothing neurotransmitters (chemical messengers) such as GABA, dopamine (which is linked to enhanced feelings of pleasure and motivation) and serotonin (which helps to regulate mood). All of this helps to slow down our heart and breathing rates, lower blood pressure and aid digestion.

What strategies could you use with stressed children to help them to return to calm – i.e. to activate their parasympathetic nervous system?

Here are some ideas:

- Listen to music
- Drawing / doodling shapes
- Deep breathing exercises
- Cuddling someone they trust
- Talk with someone they trust about how they are feeling
- Do a relaxing/pleasurable activity like playing a game or with a favourite toy (redirection)
- Go outdoors together
- Go for a walk together
- Read together
- Visualise a calm place or a happy memory
- Try the 5,4,3,2,1 exercise (pick out five things you can see, close your eyes and identify four sounds, then three sensations, two things you can smell and finally one taste)
- Place their hands on their chest and feel their heart beating
- Relax the body, from the toes upwards (visualise relaxing from the toes, up to the head)
- Close their eyes for a while
- Stand up and shake their body for one minute
- Lie on their back and stretch out their body
- Push against a wall, imaging that they are pushing their negative energy away
- Blow-painting with a straw (or blowing bubbles, blowing feathers across a table with a straw, etc)
- Focus on just one thing for a while (a noise, a smell or a sensation around them)

Section 2
Self-regulation

In this section you will learn about:

- What self-regulation means
- The five domains of self-regulation
- Stressors and the five domains of self-regulation
- Self-regulation in children with special educational needs and disabilities

What is self-regulation?

What is it that stops children (or adults for that matter) from 'flipping their lid'? The answer is self-regulation.

Self-regulation is our ability to regulate (manage) our thoughts, feelings and behaviour. It helps us to remain calm and attentive, and to deal with things like disappointment and stress.

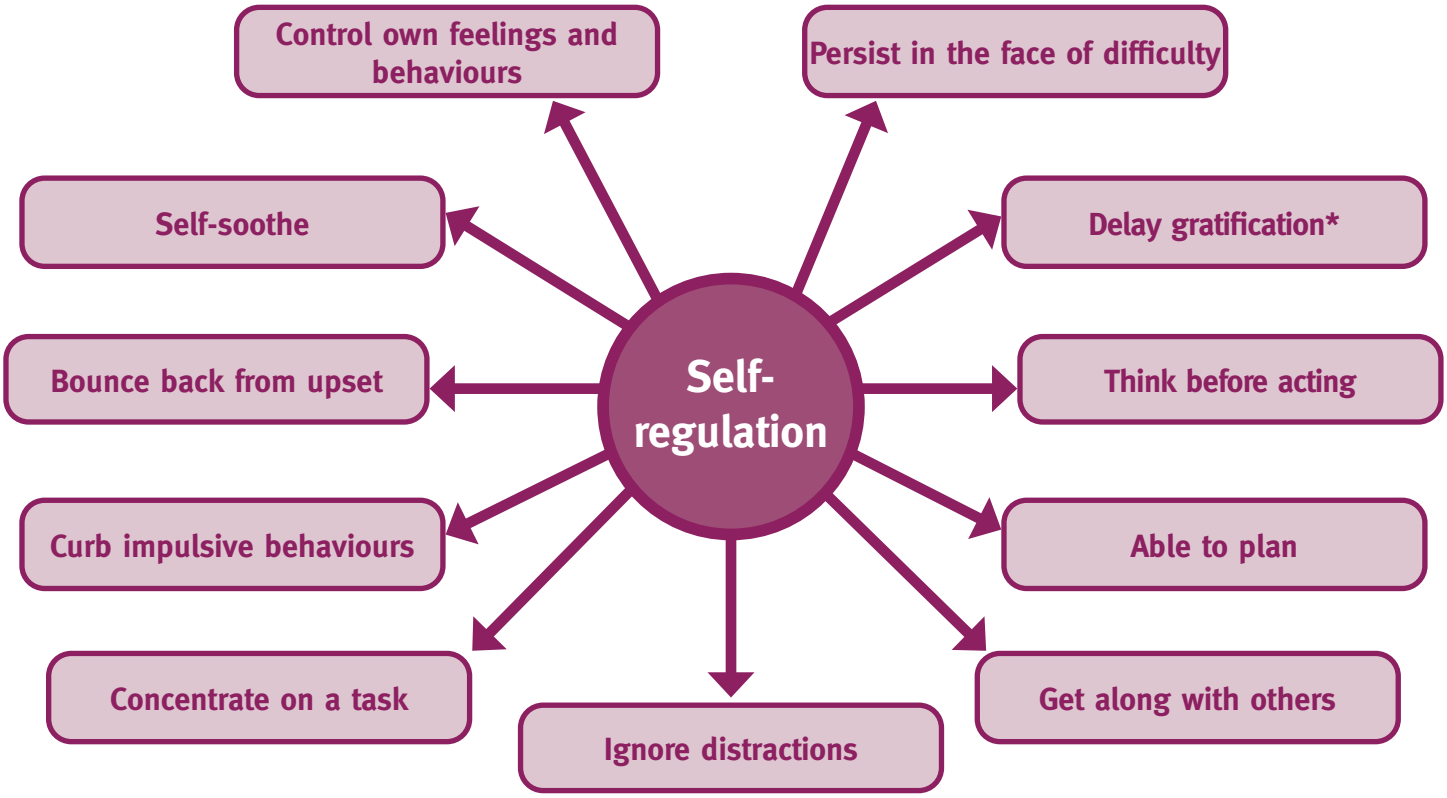
Self-regulation is a crucial set of skills that children gradually learn over time. Acquiring them helps children to control those 'big', potentially overwhelming emotions, such as anger, sadness and fear, and to manage their consequent behaviour. When a child can self-regulate, they are able to think before they act.

For example, a child who self-regulates may:

- Choose not to get involved in an argument or disagreement, instead of arguing back.
- Be more persistent in trying to solve a difficult task.
- Be able to calm themselves down before they lose control of their downstairs brain.

Self-regulation is not to be confused with self-control; they are two different things. In fact, it is only when a child learns to self-regulate their thoughts, feelings and behaviour that they are able to exert self-control. In other words, learning to self-regulate must come first.

Broadly speaking, self-regulation includes the following qualities:



* 'Delaying gratification' means resisting the temptation of immediate rewards in the hope of obtaining a more valued reward in the future.

Young children have limited capacity to self-regulate – these skills take time to develop, and young children develop their skills partly by observing other people, as you will discover in Section 3.

Unfortunately, in the meantime, many children struggle with **dysregulation** – moments or periods where they find it hard to understand and control their emotions and select appropriate behavioural responses. Dysregulation makes it difficult for children to form and keep meaningful friendships. It can also affect their ability to learn and succeed academically.

Key point

Self-regulation is the ability to regulate our thoughts, feelings and behaviour. Being able to self-regulate means being able to choose how we respond to the things that cause upset in our lives. However, children are not born self-regulators – they have to learn these skills from others.

- On a neurological level, chronic stress derails healthy brain development. The findings from neuroscience show that chronic stress can affect the size and shape of various brain structures. It can also disrupt neural connections. Ultimately, it can lead to the death of neurons.

Fortunately, if a child has a good support network in the form of family, friends, community services and school/nursery this can help to minimise the impact of chronic stress on their brain. The plasticity inherent in the developing brain means that **some of the adverse effects can be reversed if the child is in the right environment**. However, specialist support may be required to deal with the effects of childhood trauma.

Key point

Children who have been subjected to chronic stress have underdeveloped neural connections in areas of the brain responsible for learning, reasoning and memory. Left unchecked, this has worrying consequences for educational performance and behaviour.

Adverse childhood experiences

Adverse childhood experiences (ACEs) are **stressful or traumatic events that take place in childhood and can have far-reaching negative effects on a child's well-being and development**. If a child does not receive appropriate support at this time, ACEs can have an impact on them for their entire life.

ACEs include physical and emotional abuse, neglect, parental mental illness and household violence.

Read more about the CDC's ACE study here:
www.cdc.gov/violenceprevention/aces/

Researchers in the USA originally identified **ten specific ACEs**. This was based on a landmark study of 17,000 people carried out between 1995 and 1997 by the Center for Disease Control and Prevention (CDC) and the Kaiser Permanente healthcare organisation. This study remains one of the largest investigations into childhood abuse, neglect and challenging household situations, and how these directly influence a range of negative outcomes in later life. This study provided a blueprint for further research to be conducted into ACEs, and a number of other studies have concluded with similar findings.

The ten ACEs identified in the study were placed into three clusters: abuse, neglect and household dysfunction (challenges).

Abuse

PHYSICAL

EMOTIONAL

SEXUAL

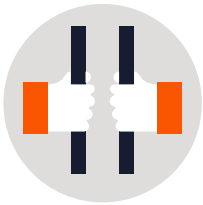
Neglect

PHYSICAL

EMOTIONAL

Household challenges

MENTAL ILLNESS IN THE HOUSEHOLD



INCARCERATED RELATIVE

MOTHER WAS TREATED VIOLENTLY

SUBSTANCE ABUSE IN THE HOUSEHOLD

PARENTAL SEPARATION OR DIVORCE

Source: The Robert Wood Johnson Foundation (www.rwjf.org)

Below are brief descriptions of the ten adverse childhood experiences that were identified by the authors of the ACEs study. Participants were asked if they had experienced any of these prior to the age of 18.

Abuse

- **Physical abuse**: Being pushed, grabbed, slapped, had something thrown at them, or hit so hard that they had marks or were injured by a parent or adult living in their home.
- **Emotional abuse**: Being insulted, humiliated, or made to feel afraid that they may be physically hurt by a parent or adult living in their home.
- **Sexual abuse**: An adult, relative, family friend, or stranger who was at least five years older than them touched or fondled them in a sexual way, made them touch their body in a sexual way or attempted to have any type of sexual intercourse with them.

The essential steps of emotion coaching

So how does emotion coaching work in practice? **Before any coaching can take place, adults need to check themselves and be aware of their own emotional state**. They need to consider whether they are in the right frame of mind to support the child at that time. Remember, children learn about how to handle emotions by watching you. Emotion coaching requires a calm and patient approach. Being emotionally self-aware will help adults to relate to the feelings of the child and others.

Once this basic requirement has been met, Gottman and his colleagues identified five steps that emotion-coaching adults should follow.

Step 1: Be aware of the child's emotions

- Minimise distractions and tune in to the child's emotional state.
- Pay attention to their body language, facial expressions and gestures.
- Observe situations and listen carefully. Learn how the child tends to express different feelings.
- Look out for the signs that the child is becoming distressed (being distant, agitated, looking sad, argumentative, etc.).

Step 2: Recognise emotional moments as an opportunity to teach and connect

- This is more a frame of mind on the part of the adult. Don't ignore or dismiss negative feelings and hope they will go away. Often, the best time to teach children about emotions is during the experience, when feelings are raw. Addressing feelings that are low in intensity before they escalate gives supporting adults the chance to practise listening and problem-solving skills (see next steps).
- Refrain from punishing dysregulated behaviour. Instead, use it as a starting point to understand where the child may need support. Remember that punishment will not teach children the skills they need to self-regulate.

How emotion coaching can support practice in early years settings

Emotion coaching supports early years practice by providing staff with an **effective strategy that helps children to learn to self-regulate their emotions and consequent behaviour**.

The research conducted by Gottman and his colleagues found that emotion-coached children:

- Achieve more academically due to being able to concentrate better and access the curriculum.
- Are more popular and socially secure (less likely to fall out with their peers).
- Have fewer behavioural problems.
- Are more emotionally stable because they have the skills to calm themselves down when they need to.
- Are more resilient (less likely to give up on tasks and more likely to bounce back from setbacks).
- Have fewer infectious illnesses as their stress response system is activated less.