



KidsMatter Early Childhood

Early childhood neurodevelopment



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While the resources are available freely for these purposes, to realise the full potential of KidsMatter Early Childhood, it is recommended that the resources be used with the appropriate training and support under the KidsMatter Initiative.

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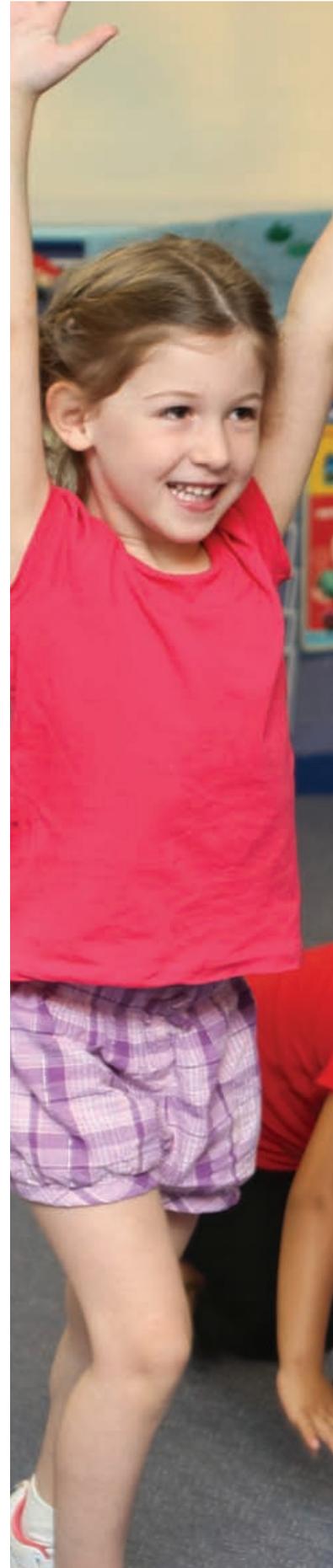
Introduction

Welcome to the KidsMatter *Early childhood neurodevelopment eBook*

This eBook focuses on early childhood brain development. The aim of the eBook is to demonstrate how the brain develops from conception to five years.

The eBook content provides a general understanding of some of the key features of neurodevelopment in the early years. It has been specifically written for early childhood education and care (ECEC) educators, but is useful for a range of audiences interested in early childhood neurodevelopment. Each section includes a summary of content about specific aspects of development. Links to other written and multimedia resources related to content in each section have also been included for those who want to learn more or go deeper.

We encourage you to use this eBook to support your ongoing learning and professional development. We hope you enjoy the resource.



Recommended reading

KidsMatter Early Childhood: A framework for improving mental health and wellbeing.

Other resources that may be of interest include:

Everyday Learning Series by Early Childhood Australia

The *Everyday Learning Series* focuses attention on the everyday ways in which young children—babies, toddlers, preschoolers—can be supported in their growth and development.

www.earlychildhoodaustralia.org.au/everyday_learning_series.html.

These resources can be purchased for a small cost from Early Childhood Australia.

Books in the series that are relevant to early childhood neurodevelopment include:

- Everyday learning about sensory learning
- Everyday learning about executive function in the early years
- Everyday learning - Physical activity—helping children grow
- Everyday learning about babies as amazing learners
- Everyday learning about responding to the emotional needs of children
- Everyday learning about play and learning
- Everyday learning about making the most of your environment
- Everyday learning about reading and writing
- Everyday learning about confidence and coping skills
- Everyday learning about maths
- Everyday learning about imagination

Research in Practice Series by Early Childhood Australia

The *Research in Practice Series* provides practical, easy-to-read resources for those involved in the early childhood field. The books are designed to assist with those challenging issues which arise in the care and education of young children, by offering effective, new approaches. www.earlychildhoodaustralia.org.au/research_in_practice_series.html.

Books in the series that are relevant to early childhood neurodevelopment include:

- [Learning and teaching through play](#)
- [The Circle of Security: Roadmap to building supportive relationships](#)
- [Discovering letters and sounds](#)
- [Young children as active learners.](#)



KidsMatter Early Childhood resources

Information for families and early childhood staff: Component 2 Developing children's social and emotional skills, KidsMatter Early Childhood:

- Helping children manage their emotions
- Helping children learn to make decisions
- Curiosity and confidence: Developing motivation
- Children and play
- Managing life's ups and downs.

Information for families and early childhood staff: Component 4 Helping children who are experiencing mental health difficulties, KidsMatter Early Childhood:

- Keeping a balance: Managing feelings and behaviours
- When times get tough: Managing trauma and ways to recover.

www.kidsmatter.edu.au/early-childhood/resources-support-childrens-mental-health/information-sheet-index-0.

Raising Children Network

The Raising Children Network is a national website which provides articles on a range of issues relevant to children's development.

www.raisingchildren.net.au.

Changing Brains

Changing Brains is a DVD for parents and educators which presents an evidence-based discussion about the brain and how it develops.

www.changingbrains.org.

Brain rules for baby

Brain rules for baby is a DVD about supporting children's brain development from birth to five years.

<http://brainrules.net/brain-rules-for-baby>.

KidsMatter

Early Childhood

neurodevelopment eBook map

SECTION	MAIN MESSAGES
The importance of the early years	<ul style="list-style-type: none"> ▪ Early experiences shape children’s brain development and can have a lasting effect on mental health and wellbeing. ▪ Positive relationships and rich learning environments promote children’s development. ▪ Early adverse experiences may alter child’s developmental progress. ▪ Children learn by interacting, observing and practising.
Brain development begins in utero	<ul style="list-style-type: none"> ▪ The anatomy of the brain and neuron. ▪ Brain development begins after conception in a sequential manner. ▪ Experiences matched with children’s neurodevelopmental level promote learning.
Early childhood development occurs in the context of relationships	<ul style="list-style-type: none"> ▪ Relationships provide children with opportunities for engagement which are essential for early brain development. ▪ Warm, responsive and trusting relationships help children to feel safe and explore their environment.
Early experiences shape children’s neurodevelopment	<ul style="list-style-type: none"> ▪ The development of the brain is use dependent. This means that it requires particular experiences and stimulation to form connections which correspond to specific skills/functions.
Children’s mental health and wellbeing is essential for brain development	<ul style="list-style-type: none"> ▪ Healthy brain development is dependent on positive social and emotional wellbeing. ▪ High levels of stress interfere with brain development and function. ▪ Early predictable warm and trusting relationships can promote better outcomes for children at risk of high stress.

<p>Children learn by interacting, watching others and practising</p>	<ul style="list-style-type: none"> ▪ Early relationships allow children to engage and attend which are necessary for learning. ▪ Play is how children learn and make sense of their world. It allows them to practise skills in all learning domains which stimulate brain development.
<p>Development of children’s social and emotional skills</p>	<ul style="list-style-type: none"> ▪ Positive relationships are at the core of children’s social and emotional development. ▪ A significant caregiver’s emotional attunement with a child supports development of self-regulation.
<p>The development of language</p>	<ul style="list-style-type: none"> ▪ Language goes through marked development in early childhood. ▪ Research indicates that there is a critical period for language development. ▪ Language development occurs in a social context, therefore children learn language by listening to it and using it.
<p>The development of learning and memory</p>	<ul style="list-style-type: none"> ▪ The process of learning takes place when repeated experiences promote the development of neuron networks. ▪ Opportunities to practise tasks that require memory improve learning.
<p>The development of self-regulation, planning and organisation</p>	<ul style="list-style-type: none"> ▪ Executive functioning refers to the range of higher order cognitive skills associated with self-regulation and goal-directed behaviours. ▪ These skills are essential for learning, developing relationships and adapting to the environment.
<p>The development of sensory motor skills</p>	<ul style="list-style-type: none"> ▪ Refers to the ability to integrate sensory and motor information to complete actions. ▪ Children develop sensory motor skills through play, by practising gross and fine motor movements and completing tasks that require them to think about where objects are located in space.

Summary

References and resources

Glossary

The importance of the early years



Early experiences shape children's brain development and can have a lasting effect on mental health and wellbeing. The brain has critical and sensitive periods when particular experiences are necessary to stimulate development of specific brain functions. Many of these experiences occur through children's relationships with their families and significant caregivers. This means that relationships are essential for children's learning and development.

Children develop in the context of relationships

From the time they're born, babies rely on the adults around them to meet their physical and emotional needs. It is through the moments of feeding, changing, bathing and play that children build relationships with their families and other adults who care for them. Warm, responsive and trusting relationships help children feel safe and secure to explore the world around them. Children learn from their relationships and their opportunities to explore as they provide the stimulation needed to promote brain development.



Children learn by interacting, observing and practising

Children learn from birth. When their significant caregivers provide nurturing care, they learn that their actions, such as crying, cooing and fussing lead to a response to their needs, such as feeding, interacting and being put to bed. These give-and-take interactions are a foundation for brain development. They give children models of how to interact with others in their environment and provide them with a basis for learning new skills. They watch those around them, absorb information from their interactions and practise what they learn through their play and behaviour.

Stress can affect children's brain development

Stress is a natural part of life and in many instances can be motivating. It is when stress becomes frequent, severe and ongoing, that it becomes damaging. Unfortunately, some children are born into circumstances where experiences of high stress are common. Chronic stress—stress that occurs often over long periods of time—affects children's relationships and puts them at great risk of altered brain development. Acute and chronic stress can become toxic. Experiences of toxic stress make it difficult for children to engage in their relationships and learning. In high doses, the hormones released during the stress response can have a damaging effect on brain cells.



How brains are built: The core story of brain development

www.albertafamilywellness.org/resources/video/how-brains-are-built-core-story-brain-development.



Brain development begins in utero

Brain development begins in the womb, with most of the structural features of the brain formed by the eighth week of conception. These structures continue to grow and develop throughout pregnancy and after birth. Brain development occurs in a sequential manner, with lower and more primitive areas developing first followed by the higher cerebrum which is responsible for more complex functions. The main structures of the brain have been associated with particular functions; however, the relationship between brain structure and function is not a simple one. Most functions occur through communication between multiple brain areas through interconnected networks of neurons.



The brain can be divided into three major parts:

Brain stem and cerebellum:

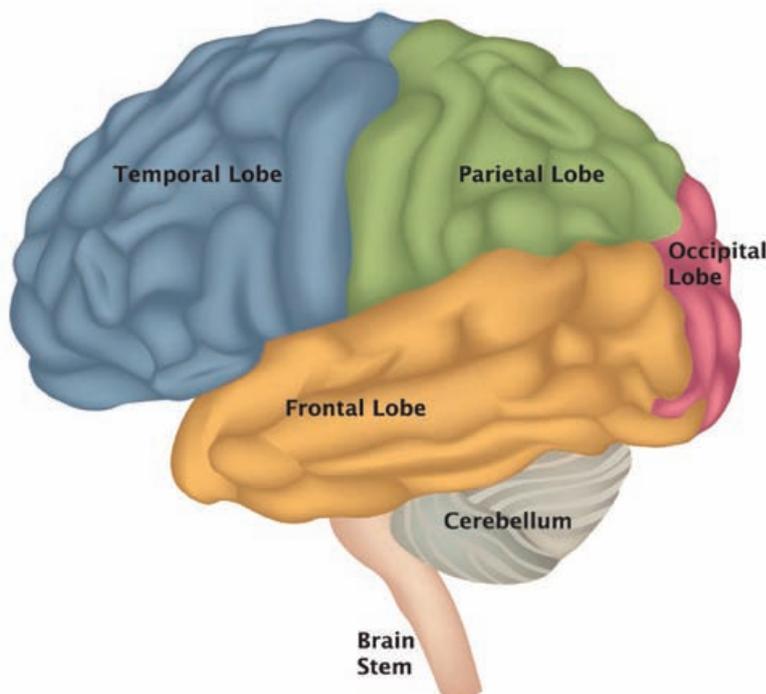
- connects the brain to the spinal cord
- is responsible for basic survival functions such as breathing, heart rate and blood pressure
- are attached to each other and together are involved in balance and coordination functions.

Limbic system:

- sits on top of the brain stem
- relays sensory information
- is responsible for a range of functions including: emotion, fear, hunger, thirst, learning and memory and circadian rhythms, which are responsible for regulating sleep and waking, hormones and temperature.

Cerebral cortex:

- is the largest part of the brain, sitting on top of the limbic system
- has a right and left hemisphere, divided into four lobes:
 - occipital lobes: control of vision
 - temporal lobes: hearing, language and social understanding
 - parietal lobes: bodily sensations, including heat, cold, pressure and pain
 - frontal lobes: memory, abstract thinking, planning and self-regulation. The outermost section of the frontal lobes, known as the prefrontal cortex, is where more complex or executive functions occur, such as attention, motivation and goal-directed behaviour.



ZERO TO THREE: Baby brain map

www.zerotothree.org/child-development/brain-development/baby-brain-map.html

The organisation of brain cells

The brain is made up of nerve cells known as neurons. Neurons communicate with each other using electrical signals. A neuron consists of a cell body, protruding branches known as dendrites and an axon.

- An axon may have multiple terminals which link to dendrites of other neurons to convey messages through electrical signals. The points at which axon terminals and dendrites meet are known as a synapses.
- Dendrites receive incoming messages from neurons, while the axon sends outgoing messages via chemicals called neurotransmitters to other neurons.
- Axons are often coated with a fatty substance known as myelin. Myelin helps electrical messages to move faster from one neuron to the next.
- The myelination of axons occurs from the foetal period into early adulthood, and it is because of this process (and only this process—adults and children’s brains are the same size) that adults can do more complicated tasks than children.

Significant milestones of foetal brain development

First trimester:

- The neural tube forms from a plate of specialised cells which will develop into the brain and spinal cord.
- The first neurons and synapses begin to form in the spinal cord, leading to first foetal movements.

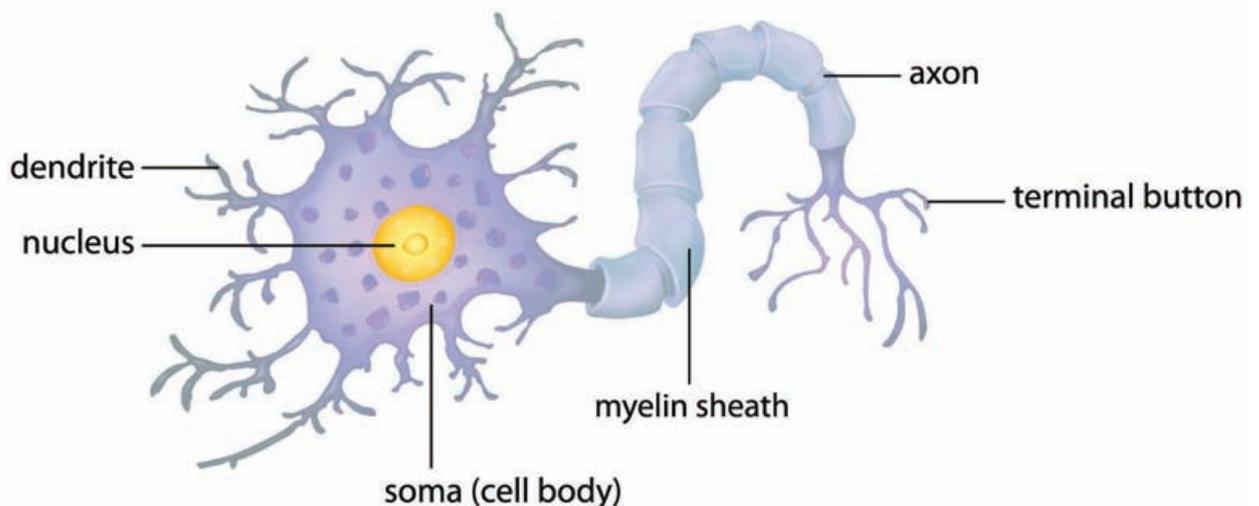
Second trimester:

- Ridges and indentations in the brain surface begin to appear.
- Thickening of cerebral cortex and formation of synapses.
- Myelination of axons commences.

Third trimester:

- Cerebral cortex begins to take over some of the functioning from the brain stem.
- Cerebral cortex begins to support early learning.

Human Neuron Anatomy



The brain develops rapidly in the first five years



Newborns:

- Brain stem most highly developed area.
- Significant development of the vision areas of the brain.
- Recognise human faces and can discriminate between facial expressions of emotion.
- Recognise family members' and significant caregivers' voices.
- Evidence of early sensory motor skills.

Babies:

- Development of head control and early motor skills such as rolling over and sitting.
- Visual areas of the brain develop leading to full binocular vision.
- Significant growth in the areas associated with learning and memory.
- Language circuits strengthen.
- Increase in sensory motor skills.

Toddlers:

- Rapid development of motor skills.
- Language areas experience increased development of synapses and interconnection.
- Significant increase in children's language abilities, vocabulary often quadruples between ages one and two.
- Increased ability to complete more complex tasks.
- Development of recognition of the self and self-awareness.
- Ability to make sense of past events and understanding of consequences of actions improve.
- Greater capacity for complex thought and cognitive flexibility.
- Development of brain areas associated with gross motor abilities.

Preschoolers:

- Further development of language areas of the brain and interconnection with other regions.
- Greater sophistication in language abilities.
- Greater integration of sensory and motor areas, related to abilities in fine motor skills.
- Greater capacity to manage emotions.
- Development of frontal lobes, associated with greater skills in reasoning and understanding of complex ideas.



Child Trauma Academy Seven Slide Series—The human brain

www.youtube.com/watch?v=uOsgDkeH52o



Baby center: Inside a child's mind

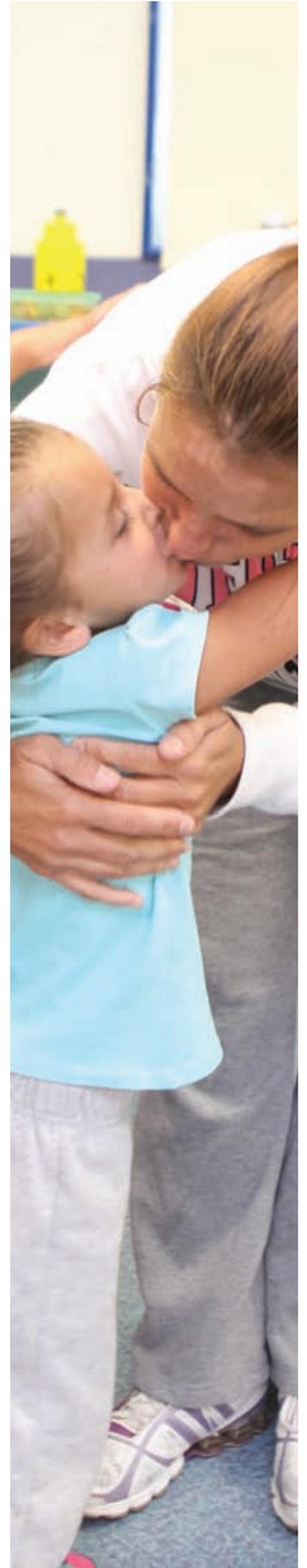
www.babycenter.com/inside-a-childs-mind-a-visual-guide

Early childhood development occurs in the context of relationships

Relationships provide children with opportunities for engagement which are essential for early brain development. Warm, responsive and trusting relationships provide the optimal conditions for children to learn and make sense of the world around them.

Warm, responsive and trusting relationships stimulate brain development

Children are born with the need to connect to others. Their first relationships with their families provide the basis for children's social and emotional learning. [Areas of the brain](#) associated with social and emotional functioning develop via the interactions that occur with significant caregivers. Children learn about their own minds when they see themselves represented in someone else's mind, and this helps them learn how to respond to others and manage their emotions through the responses they receive from those around them.





Children explore and learn when they feel safe

Warm, responsive and trusting relationships promote learning

Warm, responsive and trusting relationships with families and significant caregivers provide children with opportunities for give-and-take interactions. For example, a child might ‘give’ babbling sounds to their family member and they might ‘take’ encouraging words from their family member. This shows children that when they complete a particular action it leads to a particular response. This is the basis of children’s learning—they realise that their actions correspond with specific outcomes.

Children feel a sense of safety when their relationships are warm, responsive and trusting. Their sense of safety comes from nurturing, predictable and calm environments, where the adults around them attend to their physical, social and emotional needs. When children feel safe they can try new things and feel supported in their attempts to develop new skills. It provides them with the confidence to explore their environment and drive their own learning. When a baby knocks a hanging mobile, the mobile plays music. If they try to knock it again and it plays music they learn that they can make the mobile play music by knocking it. When an adult takes delight in this achievement, the baby’s behaviour is encouraged further. Repeated experiences such as these promote children’s learning and development.



KidsMatter Early Childhood: Growing together in relationships

www.kidsmatter.edu.au/early-childhood/about-social-development/about-social-skills/growing-together-relationships.

Center on the Developing Child, Harvard University: Young children develop in an environment of relationships

http://developingchild.harvard.edu/resources/reports_and_working_papers/working_papers/wp1/.

Child Trauma Academy—Child development and early childhood

<http://childtrauma.org/cta-library/child-dev-early-childhood/>.



KidsMatter Early Childhood: Module 3—Relationships and children’s mental health—Videos

www.kidsmatter.edu.au/early-childhood/kidsmatter-early-childhood-practice/component-2-professional-learning/module-3.

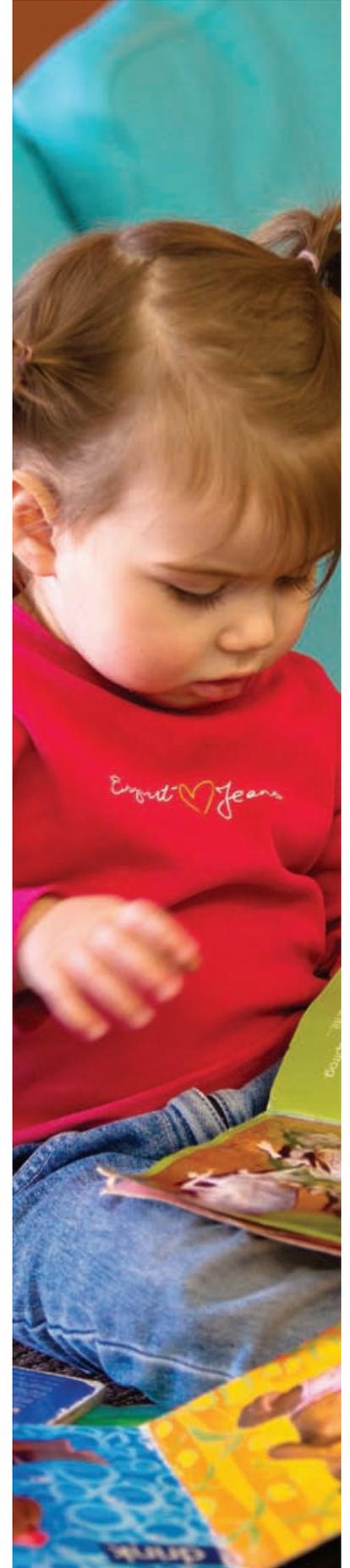
Early experiences shape children's neurodevelopment

The development of the brain is use dependent. This means that it requires particular experiences to promote neuron connectivity and the development of brain areas. Connections are strengthened when these experiences are repeated over time.

Brain development occurs when neurons form connections

When neurons form connections with other neurons, they develop networks which correspond with various skills. For example when a child is learning to ride a bike, the skills required to ride, such as balancing, pushing pedals and watching ahead need to be integrated and stored in memory. This happens with repeated opportunities to practise these skills. So, when a child comes back to riding on another day, the networks developed are activated, allowing them to get on the bike and ride without much thought.

Connections between neurons that are stimulated through experience are strengthened, while those that are not are lost. So if a child spent a day learning how to ride a bike and didn't get a chance to get on the bike again for an extended period, they may need to practise the skills needed for riding all over again.



The brain is most sensitive to input while it is developing

The types of experiences received during the early years have the greatest impact on brain development than any other stage of life.

This is because the brain is most sensitive to stimulation from the environment during this time.

There are some areas of brain development which are genetically programmed and depend on experiences to be activated. These require environmental stimulation at a particular time in development (known as a sensitive period) to activate specific brain functions (e.g. vision and language). If the experiences (e.g. visual stimuli, hearing language) are absent or limited, development of specific networks can be compromised, leading to poor functioning in particular areas (e.g. seeing, communicating).

The brain can also adapt to stimulation that does not rely on genetic programming. This occurs when repeated experiences from the environment provide the brain with stimulation, forcing it to adapt and change (e.g. becoming skilled in playing an instrument or mathematical ability). This results in individual differences in brain development.



Center on the Developing Child, Harvard University: The timing and quality of early experiences combine to shape brain architecture

http://developingchild.harvard.edu/index.php/resources/reports_and_working_papers/working_papers/wp5/.

Center on the Developing Child, Harvard University: Early experiences can alter gene expression and affect long-term development

http://developingchild.harvard.edu/index.php/resources/reports_and_working_papers/working_papers/wp10/.



Children's mental health and wellbeing is essential for brain development

Healthy brain development is dependent on positive social and emotional wellbeing. Children who feel good about themselves and can cope with challenges can make the most of learning and development opportunities.

The brain is highly interconnected

The relationship between brain structure and function is complex. There are areas of the brain that dominate particular functions (e.g. occipital lobes and vision), however, all areas of the brain are interconnected via networks of neurons which work together to support a range of processes and functions. Research has shown that brain areas related to emotional functioning can control, influence and support other functions. Emotions influence a child's capacity to self-regulate, to attend, to be engaged and to take action, all the skills required for learning to occur. This demonstrates that good social and emotional skills are the foundations of optimal learning and development. Children who are able to manage their emotions and bounce back from the challenges of life have the capacity to absorb more from the learning opportunities presented to them. Without these skills, children become easily overwhelmed by their social and emotional experiences, making it difficult for them to focus their attention on opportunities for learning. When children are feeling overwhelmed by strong emotions most of their mental resources are going in to managing those feelings, leaving less available for learning.



High levels of stress interfere with brain development

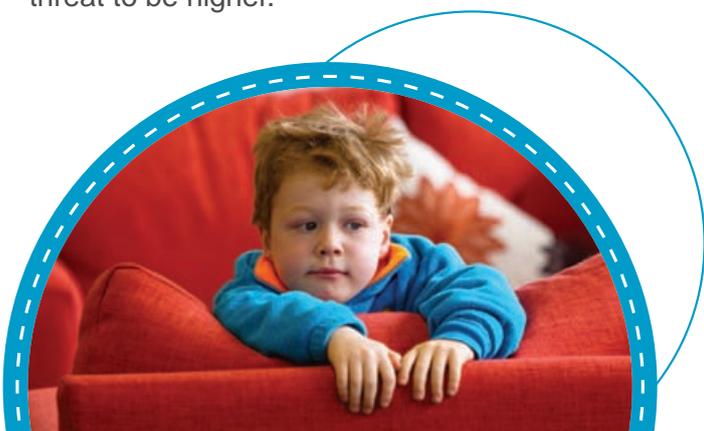
Stress is a fact of life, and in many instances has a positive influence, as it pushes children to adapt to their environment and use new skills. This supports learning and development. On the other hand, experiences of repeated high levels of stress mean that there is a constant focus on managing a threat that may be present, taking attention away from opportunities to interact with the environment in a way that supports brain development.

Abused and neglected children have often missed out on the early experiences of warm, responsive and trusting relationships which are at the foundation of healthy brain development. They have sometimes had the experience of being hurt by the person to whom they look for protection, which can lead to uncertainty, anxiety and distress. Managing this can be very stressful, and can become toxic to brain development. As a consequence, their brains begin to develop in ways to cope with these situations. Research has shown that these children have a tendency to respond with high levels of fear and hypervigilance, regardless of the level of threat present. This means that their brains have been primed to be on the lookout for constant danger, and they perceive levels of threat to be higher.

This constant warning of threat also shapes the development of the stress response system, activating it even when there is no threat present. When the stress response is activated, it releases hormones in the bloodstream that promote functions which are needed to fight with or flee from a threat (e.g. pupils dilate for better vision, blood flow is directed to the large muscles for running away). In ordinary circumstances, these hormones are beneficial as they provide the necessary capacities needed to deal with stressful situations. However, when released repeatedly and in high doses, they can have a damaging effect on the body and the brain.

There are specific areas of the brain that have receptors for stress hormones. The memory and learning area of the brain (hippocampus) in particular has high levels of receptors for stress hormones. It makes sense that stress hormones attach to this area of the brain during stressful events, as they activate memories of dealing with previous stressful experiences. This activates a previous successful strategy for a new situation. Research of abused and neglected children has shown that they have smaller hippocampal volumes, which has been related to difficulties in learning and memory.

Children who have experienced stressful events benefit significantly from warm, responsive and trusting relationships with caring adults. Repeated opportunities for such interactions can help to buffer some of their stressful experiences, supporting their learning and development.





In brief: The impact of early adversity on children's development

http://developingchild.harvard.edu/resources/multimedia/videos/inbrief_series/inbrief_impact_of_adversity/



Bruce Perry—Maltreatment and the developing child

https://childtrauma.org/wp-content/uploads/2013/11/McCainLecture_Perry.pdf

Center on the Developing Child, Harvard University: Excessive stress disrupts the architecture of the developing brain

http://developingchild.harvard.edu/resources/reports_and_working_papers/working_papers/wp3/

Uniting Care Research Paper—Using a neurodevelopmental lens when working with children who have experienced maltreatment

www.childrenyoungpeopleandfamilies.org.au/info/social_justice/submissions/research_papers_and_briefs/?a=62366



Children learn

by interacting,
watching others
and practising

The brain develops in response to the experiences offered by the environment. Children begin to learn through their first relationships with their families. As children get older, they observe how those close to them behave, and begin to practise what they see around them. Interacting, observing and practising create and reinforce networks of neurons which shape the development of the brain and how it works.

Early relationships provide a model for children's brain development

Children learn about relationships through their relationships. Warm, responsive and trusting relationships teach children that communicating their needs leads to a response from those who care for them. The relationships that children experience and those they see around them serve as a model for how to behave in relationships. This model also influences how the brain develops. Early relationships provide children with opportunities to play which has a significant role in brain development.



Children build their brains through play

Play is a vehicle for children's learning and development. It provides them with opportunities to practise what they have seen around them and learn new ways of thinking and doing things. Children's play is quite sophisticated and requires a range of skills. Play stimulates various parts of the brain, reinforcing networks and strengthening brain development. When you think about a group of children playing cooking in the home corner, there are many skills needed for them to participate in their play. They activate their:

- memory: e.g. of how the adults around them carry out cooking in the kitchen
- language: e.g. communicating effectively with their peers
- sensory motor skills: e.g. manipulating objects and putting them in the appropriate space
- self-regulation, planning and organisation: e.g. working out how they will play, how they are expected to behave in their roles and being mindful of others
- learning: e.g. how to cooperate with others
- attention: e.g. being focused and engaged in the play for an extended period of time.



Early Childhood Australia NQS PLP—Why play-based learning?

www.earlychildhoodaustralia.org.au/nqsplp/wp-content/uploads/2012/05/Why_play_based_learning.pdf

ZERO TO THREE: Tips and tools on play

www.zerotothree.org/child-development/play/tips-and-tools-play.html



Development of children's social and emotional skills

Warm, responsive and trusting relationships are at the core of healthy social and emotional development. Children's first experiences of relationships influence the architecture of the brain which forms the basis of future social interactions and management of emotions.

How relationships promote brain development

When an adult is in tune with a child's emotions, the child can see their own emotions reflected in the responses they get from those who care for them. In this way they learn how to experience, feel and manage their emotions. This learning becomes reinforced in brain connections and provides a child with a strong foundation for regulating their emotions as they get older.

When children experience warm, responsive and trusting relationships, the brain releases endorphins, which are associated with pleasurable feelings. This means that children associate 'feeling good' with social experiences.

Research has shown that the areas of the brain associated with social and emotional functioning develop in response to experiences of early relationships with families and significant caregivers. Simply hearing language (such as watching TV or listening to radio) is not sufficient to learn language; it is the intricacies of interactive relationships that promote language development in early childhood.



Limited opportunities of warm, responsive and trusting relationships affect children's development

When a child misses out on early experiences of warm, responsive and trusting relationships, the development of brain areas responsible for social and emotional functioning are compromised. This puts children at risk for having difficulties in managing emotions, forming social connections and managing their behaviour.



KidsMatter family and educator resources: Developing children's social and emotional skills

www.kidsmatter.edu.au/early-childhood/resources-educators-and-families

Early Childhood Australia—Social and emotional learning as a basis for curriculum

www.earlychildhoodaustralia.org.au/nqsplp/wp-content/uploads/2012/05/ECA-EC1101_Social-and-emotional-learning.pdf

ZERO TO THREE: Tips and tools: Promoting social emotional development

www.zerotothree.org/child-development/social-emotional-development/tips-and-tools-promoting-social-emotional-development.html



Dr Allan Schore—Neurobiology of secure attachment

www.youtube.com/watch?v=WVuJ5KhpL34



The development of language

The childhood years are considered the critical period for language development. This suggests that children need to hear, observe and engage in language interactions to be able to comprehend and use language effectively.

Language development occurs in relationships

Language development occurs in a social context. This means children need to hear language and practise using it in order to develop an understanding of how and when to use language. Children begin to acquire speech sounds very early on in life. Repeated experiences of hearing and using language with those around them allows children to develop the brain areas needed to support language functioning.

What does language look like in early childhood?

A child's first language is their cry. Children's language becomes more sophisticated as they get older. Language develops in stages dependent on age, however we also need to keep in mind that all children develop at different rates.

- At around six months of age children begin to make babbling sounds. These sounds are the early features of language.
- By around the first year children begin to use single words.
- At around the age of two children are forming short sentences.
- By about five, children are able to form complex sentences and speak fluently.

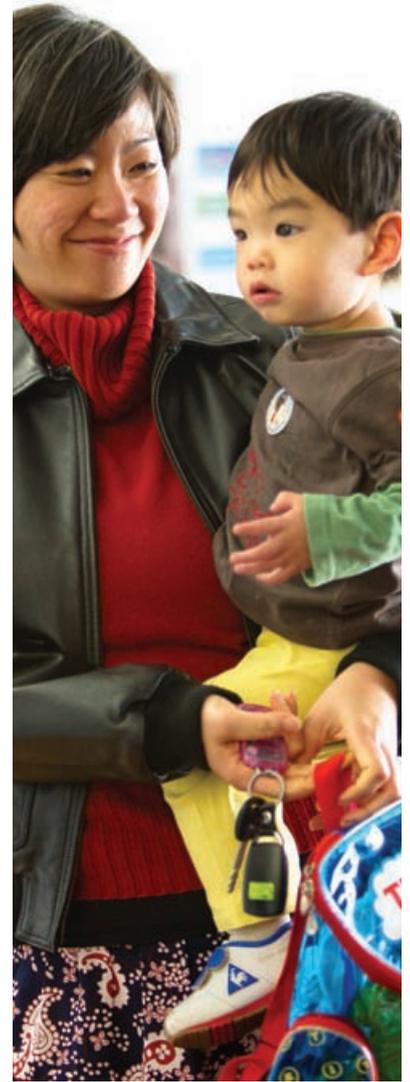


The brain and language development

The left side of the brain has been identified as the 'language centre' though, as with other skills, the functioning of language occurs via interconnected networks of different brain regions. Research has shown that the left side of the brain becomes activated when children hear speech, indicating that it plays a role in language comprehension. The right side of the brain is also involved in language function, especially in organising the motor movements associated with speech.

Supporting language development

There is a lot of evidence to suggest that reading and talking to children in the early years is associated with greater language development as they get older. Providing rich environments with lots of opportunities to read books, sing and engage in deep conversations with children are optimal for supporting language development in early childhood.



Raising Children Network: Language development

http://raisingchildren.net.au/articles/language_development.html.

Speech Pathology Australia Sound of speech birth to three

www.speechpathologyaustralia.org.au/library/2013Factsheets/Factsheet_Sound_of_Speech_0_to_3_years.pdf.

Sound of speech preschool-aged children

www.speechpathologyaustralia.org.au/library/2013Factsheets/Factsheet_Sound_of_Speech_PreschoolSchool-aged_children.pdf.

The development of learning and memory

Learning occurs through repeated experiences over time. These experiences are stored in memory for later use. Learning has taken place when a child is able to retrieve these experiences from memory and use them for recognition, completing tasks and solving new problems.

Learning and memory in the brain

The process of learning takes place when neurons are repeatedly activated via stimulation from the environment which strengthens connections in the brain. Though these structures are present from birth, they are not largely developed until two years of age. Evidence of early memory functioning can be seen in babies' capacities to recognise and show preferences for faces they have seen more often. As children get older, especially by around the first year, they have greater capacities for recalling information from memory. Their abilities to recall further improve over the second year, showing greater reliability of the information retrieved.



Supporting learning and memory

An environment that promotes exploration supports children's learning and memory.

- It encourages children to try new things, to take risks and to practise what they have learnt.
- Opportunities to practise tasks that require children to recall information from memory support learning.
- As memory is reliant on good language skills, supporting children's **language development** will also improve memory and learning.



Encyclopedia on early childhood development: Memory and early brain development

www.ccl-cca.ca/pdfs/ECLKC/encyclopedia/Enc08_Bauer-Pathman_brain_en.pdf



The development of self-regulation, planning and organisation

Executive functioning refers to the broad range of higher order cognitive skills associated with self-regulation and goal-directed behaviours. Planning, organisation, information updating, concept formation (e.g. understanding that a cow and horse are different due to specific features), reasoning and impulse control are just some of the abilities that fall under the umbrella of executive functioning. These skills allow us to attend to, hold and manipulate information in mind while filtering out distractions. They also help us to: divide our attention when faced with competing sources of information, monitor errors, make decisions, develop goals, make changes to plans and resist urges to react in certain situations. The executive functions play a complex role, overseeing the functions of all the other areas of brain.



Development of the executive functions

The executive functions are thought to be mediated by networks of different brain regions. Therefore they are very sophisticated brain functions. The frontal regions of the brain are the last to develop. This coincides with the length of time it takes for the executive functions to fully emerge. The executive functions begin to develop in early childhood and continue on until adolescence and early adulthood. Networks required of executive abilities are established in early childhood. They are then refined and reorganised in adolescence, especially in the frontal areas of the brain. This increases efficiency of the networks involved in executive functioning, continuing into early adulthood.

Successfully laying down the foundations of these skills in the early years is essential for children's learning and development. Children use their early executive function skills in learning how to read, write, solve problems, form friendships and engage in play. These skills cut across all areas of functioning; without them, doing day-to-day things is difficult, while more complex tasks would be near impossible to manage.

Supporting executive function development

Children develop their executive skills through the support of adults. Babies and toddlers are not yet fully capable of understanding the consequences of their actions, how to plan, organise and regulate their behaviour. Adults support children's executive capacities by responding to their emotional needs, setting up routines and prompting them through new experiences. This is known as scaffolding, where adults provide a supportive framework for children to observe, practise and eventually acquire new skills.

Engaging in play with others is one way children practise their executive skills. Play gives them the opportunity to use the skills they have been developing with the support of the adults around them. For example, when children play a game of 'shops' they need to decide what they will use for props, plan who will be the shopkeeper and who will be the customers. They also need to have an understanding of what happens when you go to a shop. This kind of dramatic play requires children to monitor who's doing what and how to adapt as the play unfolds—this is evidence of their developing executive functions. Adults can further encourage the development of these skills by extending children's play. Using the example above, they might question the children about how much something costs, how they have organised things in the shop or what they might do if someone is unhappy with their purchase.



NQSPLP Video—The Café

This video clip of children playing demonstrates how children use their executive skills in play.

www.earlychildhoodaustralia.org.au/nqsplp/e-learning-videos/connecting-with-practice-eylf-nqs/the-cafe/.

The executive functions oversee all areas of development

Research has shown that having well-developed executive capacities has the greatest impact on academic success. This is because the executive functions cut across all areas of development. They bring various areas of brain functioning together to complete complex tasks, which require the use of different skills simultaneously.

Being able to plan, organise, focus attention, cooperate, problem solve and use self-regulation are necessary for learning experiences and social interactions. A child who has limited abilities of executive function will struggle to learn and get along effectively with other children and adults.



In brief: Executive function: Skills for life and learning

http://developingchild.harvard.edu/resources/multimedia/videos/inbrief_series/inbrief_executive_function/.



Center on the Developing Child, Harvard University: Building the brain's 'air traffic control' system: How early experiences shape the development of executive function

http://developingchild.harvard.edu/resources/reports_and_working_papers/working_papers/wp11/.



The development of sensory motor skills



Sensory motor skills are the first to emerge in early childhood development. They involve taking in information from the senses and integrating it with motor movements to complete actions. Sensory motor skills are needed for a wide range of tasks, and play a key role in **self-regulation**. They are essential for learning and development. A well-integrated sensory motor system supports play, self-confidence, self-care skills, academic learning and executive functioning.

The senses

Taste, touch, hearing, sight and smell are often what spring to mind when asked about the senses. We also have movement-based senses known as:

- proprioception which gives us feedback from the muscles and joints about where our bodies are located in space
- kinesthesia which allows us to sense muscle and joint movement
- vestibular senses which provide us with information about balance and equilibrium.

Integration of sensory and motor skills

Information from sensory experiences is critical for brain development. Young children learn to integrate sensations, bringing together all the information from the senses to complete actions. As children get older, they move onto perceptual motor development where they receive, interpret and respond to sensory information according to previous experiences. This is when children can take in information from the senses (e.g. touching a hot stove), integrating it with a motor movement (e.g. pulling the hand away) and storing the experience in memory for the future (e.g. avoiding heated objects because they cause pain). Sensory motor skills are essential for speech, play, learning and fine and gross motor movements.

Supporting sensory motor development

Sensory motor skills are needed to function effectively in day-to-day life. This means that experiences which promote these skills are easily found in the environment. Opportunities for sensory play using natural materials and everyday moments engage children's senses and support their learning and development.

Body awareness

Children develop good movement skills from having a strong awareness of their bodies. This awareness allows them to understand:

- their body parts
- the size and weight of their bodies
- the shapes their bodies can make and how they fit in different spaces.

Body awareness involves the integration of touch, proprioceptive and vestibular senses.

Touch

Touch is transmitted to the brain via sensory receptors in the skin. It provides children with information about the elements of how things feel, such as pressure, temperature and pain. Offering opportunities for children to experience different sensations of touch through different textures and various means supports their development.

Vision and hearing

Vision develops early in life and babies need to see a variety of things to develop effective vision. Babies love looking at faces and learn to differentiate between them from an early age. Providing opportunities for children to see a range of colours, contrasting patterns and different designs at different depths, all promote the development of vision.

Listening to sound stimulates the brain and supports the development of language. Talking and singing to children allow children to hear language which helps them to integrate the motor movements required of speech.

Taste and smell

Children develop the senses of taste and smell by being given opportunities to experience various tastes, smells and textures. This is usually through food; as babies and as children get older they can experience and understand the different scents that are present in their environments.



Vestibular (sense of gravity and balance)

Receptors in the inner ear provide information about sense of gravity and balance. This gives children awareness of how their bodies are placed in space and helps them to orient their movements. Offering children opportunities to demonstrate their body awareness in experiences such as balancing, jumping, rocking and swinging support vestibular development.

Proprioceptive and kinesthesia (sensing muscle and joint movement)

Receptors in muscles, joints and ligaments send signals to the brain about where a child's body is positioned in space and when their limbs are moving. Pushing, pulling and weight-bearing movements require the use of proprioceptive senses and help develop greater body awareness.



Motor planning and coordination relies on the senses

Motor planning is the ability of a child to be able to coordinate their motor movements. It allows them to adjust their movements in response to feedback from the senses. Having well-developed awareness of the senses provides children with all the information they need to complete a particular action. These skills enable children to explore their environment, take in further sensory information and develop, learn and refine new capacities such as eye-hand coordination, visual spatial perception, speech and language.

**ZERO TO THREE: Babies and their senses**

www.zerotothree.org/child-development/temperament-behavior/babies-and-their-senses.html.

Early Childhood News: Optimizing early brain and motor development through movement

www.earlychildhoodnews.com/earlychildhood/article_view.aspx?ArticleID=360.

Summary

Brain development begins well before children are born and continues on until adulthood. Experiences in early childhood form the foundations for children’s learning and development throughout life. The brain needs a variety of experiences to develop.

- Warm, trusting and responsive relationships with significant caregivers provide the optimal conditions for healthy brain development to occur.
- It is through these relationships that children gain experiences needed to support brain development.
- Neurons in the brain form connections in response to repeated experiences from the environment. This means that children develop the capacities that help them to adapt to the needs of their environments.
- Children’s mental health and wellbeing is essential for brain development: it enables children to attend to, focus on and participate in learning experiences.
- Children learn by interacting, observing and practising. Opportunities to play provide children with the conditions to practise, learn and develop new skills.
- Social and emotional skills are at the core of all learning and development.
- Language develops significantly during early childhood. Hearing and engaging in language interactions support children’s development.
- Learning occurs through repeated experiences children receive from their environment.
- Executive function skills encompass all areas of development. They oversee the functioning of all areas of the brain. They allow children to demonstrate self-regulation, planning, organisation and reasoning skills, which are needed in academic and social pursuits.
- Sensory motor skills help children take information in from the environment and use it to support exploration and learning.

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Glossary

Babbling	When babies develop the control of opening and closing of the vocal tract, they are able to differentiate the sounds of vowels and consonants. This means they can babble which is demonstrated by repeated sounds containing alternations of vowels and consonants (e.g. baba or dede).
Cerebrum	The outer part of the brain which sits on top of the brain stem.
Circadian rhythms	Daily cycles of activity seen in living things.
Cognitive flexibility	The capacity to shift thinking between multiple concepts.
Cortex	The outer layer of the cerebrum (the cerebral cortex), composed of folds and indentations (gyri and sulci).
Environment	The surroundings or conditions in which a child operates.
Fine motor skills	Small movements controlled by smaller muscles in the body such as in the fingers and toes.
Genetic programming	Development that occurs as a consequence of inherited genes.
Gross motor skills	Movements controlled by larger muscle groups such as running and throwing.
Maltreated children	Children who have experienced abuse (i.e. physical, sexual, emotional) and/or neglect.
Networks	Connections of neurons which form to link various parts of the brain.
Neural tube	The hollow structure of cells from which the brain and spinal cord form in an embryo.
Neurotransmitters	A chemical substance which is released at the end of an axon by the arrival of an electrical signal from another neuron. Neurotransmitters move across synapses allowing the transmission of the electrical signal to another neuron, muscle fibre or other organ in the body.
Significant caregiver	Individuals who take primary responsibility for the care of a child.
Stress hormones	Hormones (e.g. cortisol and epinephrine) that are released in response to events that are interpreted as dangerous.



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