

## Brain development in early childhood



### Introduction

Early childhood is a time of rapid development and significant opportunity for learning; more so than any other stage of life [1, 2]. How a child experiences the world during these early years lays the foundations for their lifelong health and wellbeing [2]. A healthy and positive start in life can enable a child to successfully manage everyday challenges, develop a sense of personal wellbeing, build relationships and reach their full potential [3].

### The science of brain development

Development of the brain begins within the first few days after conception and continues into the adult years [3]. During the first few years of life, more than 1 million neural connections are formed within the brain every second [4]. Neurons and their connections are the “bricks, mortar and wiring” of brain-building, providing a sturdy or weak foundation for later skill development [5]. A natural process of the brain called ‘pruning’ continuously takes place, where some connections are reduced and others are strengthened in response to the experiences a child has in their early years [5, 6]. In this way, brain development involves a delicate balance between ‘nature and nurture’ (biology and the environment) [7, 8].

Different parts of the brain develop in a predictable sequence, from the bottom up, and higher-level skills are difficult for children to master if the development of their lower-level skills is impaired [8]. Those areas of the brain critical to sustaining survival develop first, regulating functions such as breathing, heart rate and blood pressure. Other areas follow, such as the regions of the brain that control posture, balance and coordination [9], and those responsible for sensory development, hunger, thirst and body temperature [10]. Building on these foundations, the frontal

lobe then begins to develop in the preschool years and is responsible for memory, abstract thinking, planning, self-regulation, attention, motivation and goal-directed behaviour [10]. Key aspects of brain development in the early years are further summarised in Table 1.



**Table 1: Brain development in the early years**

Age	Brain Development
<b>Newborn</b>	<ul style="list-style-type: none"> <li>Brain stem is the most developed area</li> <li>Significant development of vision areas of the brain</li> <li>Able to recognise human faces</li> <li>Recognise family members' and significant caregivers' voices</li> <li>Early sensory motor skills</li> </ul>
<b>Babies</b>	<ul style="list-style-type: none"> <li>Development of head control and early motor skills</li> <li>Visual areas of the brain continue to develop</li> <li>Growth in the areas associated with learning and memory</li> <li>Language circuits strengthen</li> </ul>
<b>Toddlers</b>	<ul style="list-style-type: none"> <li>Rapid motor skill development</li> <li>Language areas of the brain experience increased development of synapses and interconnection</li> <li>Increased ability to complete more complex tasks</li> <li>Development of recognition of the self and self-awareness</li> <li>Understanding of consequences of actions improve</li> <li>Greater capacity for complex thought and cognitive flexibility</li> </ul>
<b>Preschoolers</b>	<ul style="list-style-type: none"> <li>Further development of language areas of the brain</li> <li>Greater integration of sensory and motor areas</li> <li>Greater capacity to manage emotions</li> <li>Development of frontal lobe associated with greater skills in reasoning and understanding complex ideas.</li> </ul>

Source: KidsMatter Early Childhood, 2014

### Sensitive periods of brain development

How a child experiences the world in the early years literally shapes the structure and function of their brain. Sensitive periods of brain development are unique windows of opportunity when the influences of environment and experience are particularly important<sup>[11]</sup>. Sensitive periods begin and end at different ages, for different parts of the brain. For example, sensitive periods related to vision, hearing and touch end in the first years of life, whereas sensitive periods for communication, reasoning, decision making and emotional regulation take place at later stages of child development, when higher levels of the brain are developing<sup>[2, 8]</sup>. Whilst these sensitive periods are important for healthy brain development, children may still be able to recover, or make up for missed experiences<sup>[9]</sup>. However, providing the right conditions for healthy development early produces better outcomes than trying to address problems later.

### The role of relationships and stress

The family environment and relationships with caregivers are integral in shaping a child's skill development in the first few years of life. The quality of relationships is vital for social, emotional and intellectual development, and can influence motivation to learn and school achievement, as well as later life outcomes<sup>[12, 13]</sup>. Healthy brain development in early childhood occurs through a particular type of interactive relationship between children and their caregivers. When a child seeks to communicate with the adults who care for them, through babbling, gestures and facial expression, these act as 'serve' for interaction. Responsive adults who 'return' these serves then provide emotional support and similar expressions and vocalisations<sup>[2]</sup>. When a child is deprived of these vital 'serve and return' interactions, it can weaken the developing brain, harming future learning, behaviour and health<sup>[5]</sup>.

Nurturing, stable and predictable experiences in early childhood can foster rich learning opportunities to support healthy brain development<sup>[2]</sup>. However, if a child is exposed to highly stressful early life experiences which are filled with threat, uncertainty, neglect or abuse, this can disrupt brain development and impact on their ability to effectively respond to stressful experiences later in life<sup>[2]</sup>. Some stress is a normal and important aspect of child development as it helps a child to learn how to cope with adversity. However, when this stress is extreme or ongoing and the protection of a responsive caregiver is unavailable, this can have severely negative consequences on child development and lifelong health<sup>[2]</sup>.

### Conclusion

The science of brain development in early childhood has made an important contribution to understanding the core foundations of learning, behaviour and lifelong health<sup>[2]</sup>. A poor start in life can undermine brain development and restrict a child's capacity to develop a range of skills and competencies, thus limiting their contribution to their community<sup>[3]</sup>. However, predictable and responsive relationships with caregivers, and access to safe, protective environments can provide the right conditions for healthy brain development and help protect young children from the harmful effects of adversity<sup>[14]</sup>. Such investments into the early years can have far-reaching consequences not only for the child, but also for future generations, and on the future prosperity and productivity of society<sup>[2]</sup>.

## References

1. Phillips, D. A., & Shonkoff, J. P. (2000). From neurons to neighborhoods: the science of early childhood development. Washington, D.C.: National Academies Press. doi:10.17226/9824
2. Center on the Developing Child at Harvard University. (2016). From best practices to breakthrough impacts: a science-based approach to building a more promising future for young children and families. Retrieved from <http://developingchild.harvard.edu/>
3. Center on the Developing Child at Harvard University. (2010). The foundations of lifelong health are built in early childhood. Retrieved from <http://developingchild.harvard.edu/>
4. Center on the Developing Child at Harvard University. (2009). Five numbers to remember about early childhood development. Retrieved from <http://developingchild.harvard.edu/>
5. Center on the Developing Child at Harvard University. (2016). Applying the science of child development in child welfare systems. Retrieved from <http://developingchild.harvard.edu/>
6. Kolb, B., Mychasiuk, R., Muhammad, A., Li, Y., Frost, D., & Gibb, R. (2012). Experience and the developing prefrontal cortex. In Proceedings of the National Academy of Sciences (Vol. 109, pp. 17186–17193). doi:10.1073/pnas.1121251109
7. Oberklaid, F. (2007, December). Brain development and the life course - the importance of the early caretaking environment. Putting Children First, pp. 8–11. Melbourne, Australia. doi:10.1111/j.1365-2214.2006.00632.x
8. Winter, P. (2010). Engaging families in the early childhood development story. Education Services Australia (Vol. 28). Victoria, Australia. doi:10.1017/CBO9781107415324.004
9. Child Welfare Information Gateway. (2009). Understanding the effects of maltreatment on brain development. Retrieved from [www.childwelfare.gov](http://www.childwelfare.gov)
10. KidsMatter Early Childhood. (2014). Early childhood neurodevelopment. Retrieved from <https://www.kidsmatter.edu.au/>
11. Center on the Developing Child at Harvard University. (2007). The timing and quality of early experiences combine to shape brain architecture. Retrieved from <http://developingchild.harvard.edu/>
12. Francesconi, M., & Heckman, J. J. (2016). Child development and parental investment: introduction. The Economic Journal, 126, F1–F27. doi:10.1111/eoj.12388
13. Center on the Developing Child at Harvard University. (2004). Young children develop in an environment of relationships. Retrieved from <http://developingchild.harvard.edu/>
14. Shonkoff, J. P. (2016). Capitalizing on advances in science to reduce the health consequences of early childhood adversity. JAMA Pediatrics, 301(21), 2252–2259. doi:10.1001/jamapediatrics.2016.1559