The Brain

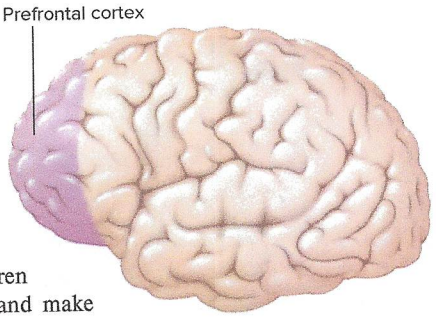

Figure 1 The Prefrontal Cortex The brain pathways and circuitry involving the prefrontal cortex (shaded in purple) show significant advances in development during middle and late childhood. *What cognitive processes are linked with these changes in the prefrontal cortex?*

One of the most important physical developments during early childhood is the continuing development of the brain and other parts of the nervous system (Bell, Broomell, & Patton, 2018; Bell & others, 2018). The increasing maturation of the brain, combined with opportunities to experience a widening world, contribute to children's emerging cognitive abilities. In particular, changes in the brain during early childhood enable children to plan their actions, attend to stimuli more effectively, and make considerable strides in language development.

Although the brain does not grow as rapidly during early childhood as in infancy, it does undergo remarkable changes. By repeatedly obtaining brain scans of the same children for up to four years, researchers have found that children's brains experience rapid, distinct spurts of growth (Gogtay & Thompson, 2010). The overall size of the brain does not increase dramatically from ages 3 to 5; what does change dramatically are local patterns within the brain. The amount of brain material in some areas can nearly double in as little as a year, followed by a dramatic loss of tissue as unneeded cells are pruned and the brain continues to reorganize itself. From 3 to 6 years of age the most rapid growth in the brain takes place in the part of the frontal lobes known as the *prefrontal cortex* (see Figure 1), which plays a key role in planning and organizing new actions and maintaining attention to tasks (Gogtay & Thompson, 2010).

The continuation of two changes that began before birth contributes to the brain's growth during early childhood. First, the number and size of dendrites increase, and second, myelination continues. Recall that **myelination** is the process through which axons (nerve fibers that carry signals away from the cell body) are covered with a layer of fat cells, which increases the speed and efficiency of information traveling through the nervous system. Myelination is important in the development of a number of abilities (Juraska & Willing, 2017; van Tilborg & others, 2018). For example, myelination in the areas of the brain related to hand-eye coordination is not complete until about age 4. Myelination in the areas of the brain related to focusing attention is not complete until the end of middle or late childhood. And myelination of many aspects of the prefrontal cortex, especially those involving higher-level thinking skills, is not completed until late adolescence or emerging adulthood (Bell, Ross, & Patton, 2018; Cohen & Casey, 2017; Dahl & others, 2018). In a recent study, young children with higher cognitive ability showed increased myelination by 3 years of age (Deoni & others, 2016).

Recently, researchers have found that contextual factors such as poverty and parenting quality are linked to the development of the brain (Black & others, 2017; Farah, 2017; Marshall & others, 2018). In one study, children from the poorest homes had significant maturational lags in their frontal and temporal lobes at 4 years of age, and these lags were associated with lower school readiness skills (Hair & others, 2015). In another study, higher levels of maternal sensitivity in early childhood were associated with higher total brain volume (Kok & others, 2015).

Motor Development

Running as fast as you can, falling down, getting right back up and running just as fast as you can . . . building towers with blocks . . . scribbling, scribbling, and scribbling some more . . . cutting paper with scissors . . . During your preschool years, you probably developed the ability to perform all these activities. What physical changes made this possible?

Gross Motor Skills

The preschool child no longer has to make an effort simply to stay upright and move around. As children move their legs with more confidence and carry themselves more purposefully, moving around in the environment becomes more automatic (Hockenberry, Wilson, & Rodgers, 2017; Perry & others, 2018).

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