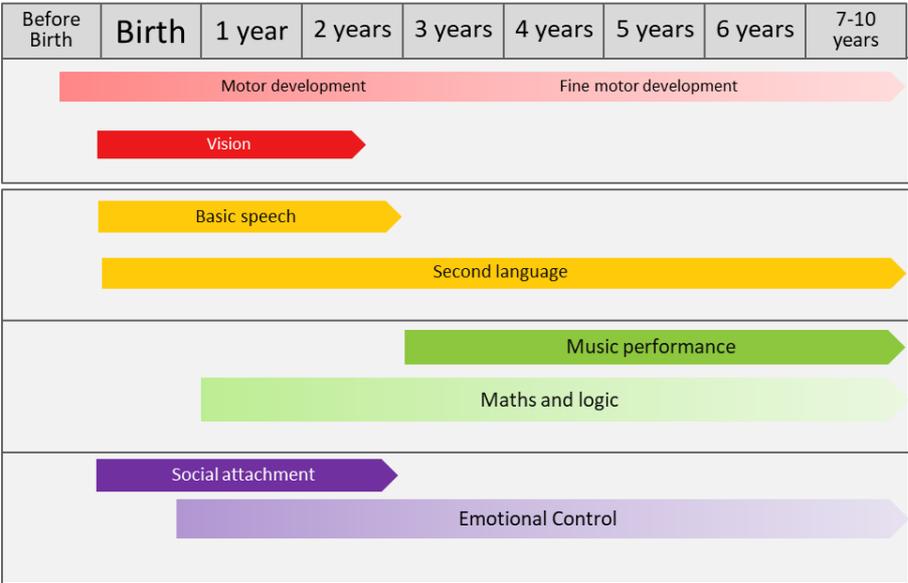


# Neuroscience: Puberty Blockers and The Teenage Brain

As you might expect for such a complex organ, the human brain develops in a remarkable way. Most of our neurons (the brain cells that send electrical signals to each other to enable us to sense the world around us and think and feel and move) are in place by the time we are born. Cognitive development isn't just a question of connecting up the cells we are born with; it is also important to get rid of the connections we don't need anymore, a process called pruning. In normal brain development, the establishment of new connections is synchronised with the pruning of connections that are no longer required. The chemical signals that govern these processes are released in stages and target different regions of the brain at different ages, resulting in a predictable sequence of development throughout childhood and adolescence and well into the third decade of life.

Neuroscientists have developed the concept of "Windows of opportunity" to describe the age sensitive periods in children's lives that represent the optimum periods for the development of specific functions. See Figure 1.

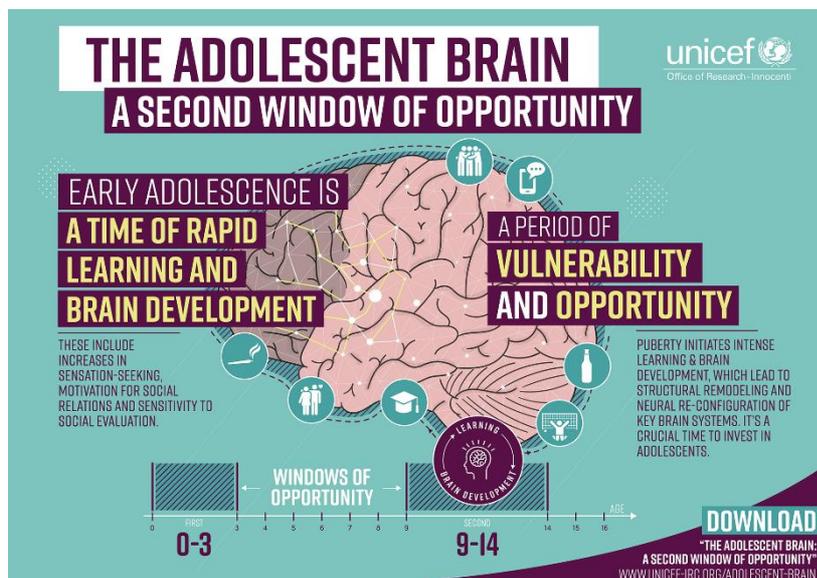
Figure 1: Developmental 'Windows of Opportunity' in childhood.



These are the times when specific functions develop at an incredible rate. If children are deprived of the appropriate environment at these critical times, the window of opportunity closes and they are often left with lifelong difficulties in that area. It's not possible to just 'pause' development. For example, the window of opportunity for sight is open from birth, but closes relatively early. If babies were blind-folded or brought up in the pitch dark for the

first few years of their life they would not be able to develop normal sight even if the blind fold was removed or the lights were turned on when they were toddlers. The window of opportunity will have already closed. Anyone who tries to learn a new foreign language as an adult is doing so once the 'language window' has closed. They may be able to master the new language but they will always speak it with an accent, unlike bilingual children who acquire the language when the 'window' is open. There is a reason we have a national reputation for being very poor at second languages: most children in the UK only begin to learn a second language at secondary school when the language window is all but closed.

Adolescence has been described as the second window of opportunity in neurodevelopment [1]. See Figure 2



From: <https://www.unicef-irc.org/article/1750-the-adolescent-brain-a-second-window-of-opportunity.html>

Puberty doesn't just involve the development of secondary sex characteristics. It's a whole system change that has profound and irreversible effects on the brain as well as the body. It's the time where the brain decides which connections

are important to keep and which can be let go. The pruning that occurs in our teenage years helps the brain transition from childhood to adulthood. At present, we just don't know the impact of puberty blockers on this critical stage of neurodevelopment and subsequent lifelong brain function in adulthood. The 'windows of opportunity' model indicates that rather than a whole system pause, some parts of brain development may continue regardless, but without the expected hormonal regulation, the process may well be disrupted. One theory of why pruning is so prolific in adolescence is that maintaining redundant connections between the brain cells uses nutrients which may be needed elsewhere in the body during growth and sexual maturation. If sexual maturation is artificially 'blocked' what happens to this vital pruning process? The answer is that we just don't know. These drugs were not developed to block normal puberty. If they had been, they would have undergone extremely rigorous testing with respect to their impact on cognitive development, to ensure that anyone choosing to take them was able to make an informed decision, aware of all of the potential advantages and side effects.

To find out more about how the teenage brain develops, interested readers are encouraged to look at the proceedings from the Unicef symposium on 'The Adolescent Brain' held in

2016. See <https://www.unicef-irc.org/publications/933-the-adolescent-brain-a-second-window-of-opportunity-a-compendium.html>

[1] Balvin, Nikola; Banati, Prerna (2017). The Adolescent Brain: A second window of opportunity - A compendium, MiscellaneaUNICEF Office of Research - Innocenti, Florence