

Brain Development

An overview

New understanding about the brain reveals that babies are emotionally sensitive long before birth. They are born ready and needing to be in relationships - and what they experience has an impact for life.

Emotional experiences shape brain development. Feeling safe and content, feeling loved and heard, and physically in touch with a loving adult (preferably mum), are keys for your baby's optimal brain development, and for health.

The early years matter

Unwittingly, we each have a tendency to recreate the experience of our childhood, including the hugely influential period we spend in the womb, for the rest of our lives – and brain science now reveals the mechanisms behind this.

Pregnancy: What your baby experiences from conception onwards influences the developing structure and the function of her brain. Nutrients that travel to your baby via the placenta are only part of her nutrition. The emotional aspect of womb life is also important. Being exposed to high stress levels and fear in the womb is very different from an environment of safety and ease.

The emotions that influence your baby in pregnancy impact the formation of networks in her brain. Later in life, right into adulthood, the neural networks that formed at this early stage still have an influence. Anxiety in the womb, for instance, in response to fighting or high levels of fear or anxiety in mum, primes a baby's brain to repeat the anxiety response in similar situations after birth, and perhaps for years to come. In a similar way, feeling content, calm, wanted, loved and safe while in the womb inclines a person to expect loving relationships and repeat calm and loving behaviour.

As a baby: Experiences after birth are similarly important. A baby who learns that relationships are fun, trusting, safe and pleasurable, will be inclined to seek out more friendships in adulthood.

Social brain: being in relationship, being emotional

Human brains have evolved to incline us to be deeply sociable creatures. Each neuron (brain cell) develops very specifically so that it will respond to certain stimuli. For instance, certain neurons are primed to respond to eye contact and the emotional messages conveyed by facial expressions: from the moment we are born we are able to recognise fear, disgust, love or anger in others' faces. We respond instantly and unconsciously.

Cells designed to fire in response to eye contact and facial expressions, and to touch, are located within parts of the brain that assign emotional value, or categorise the experience as if it is good or

bad, safe or dangerous. These parts include the amygdala and orbitofrontal cortex, both in the limbic brain. Their pivotal role in our learning is crucial: we learn according to the emotions we feel.

Seeking eye contact is an in-born tendency of the brain, as active as the urge to seek out the nipple, and is active at birth. From the moment we take our first breath we are compelled, driven, to invite our parents to bond and dance with us. We are all born with the tendency to seek proximity with a care giver.

In a similar way, specific cells drive us to explore our environment, in search of discovery and novelty. The experiences we gain from exploring, and from being in contact with our parents, encourage new growth of brain cells (neurogenesis) and the creation of new neural networks: it is these networks that allow us to learn, and to remember the people in our family and wider social group.

Crocodiles, mammals and humans; a story of brain evolution

The human brain has evolved over eons. In a simplistic but significant way, the brain can be viewed in three sections (as a 'triune' brain); each one is a product of evolution.

Crocodile or 'reptilian' brain At the core of our brain is the most ancient, 'reptilian brain', a network of specialised nerve cells and brain matter that evolved among reptiles hundreds of millions of years ago. The way this area of our brain functions remains largely unchanged since ancient times. It's in charge of survival – controlling essential bodily functions including hunger, circulation, heartbeat, temperature, breathing, balance, movement and digestion. It also gives us territorial instincts, drives us to mate, and is the source of our fight-or-flight reflex.

Reptiles do not have emotions and feelings. The 'reptilian' brain equips us with basic survival instincts, but it does not offer us a capacity for love, bonding, or protecting our mates. A baby crocodile, for instance, may one day be snapped up by the father crocodile or another predator and the mother will feel nothing. This is in stark contrast to elephants, who are known to grieve when a family member dies. Why are they different? Elephants have a mammalian brain.

Mammalian or 'limbic' brain In evolutionary terms, the next stage in brain development is the arrival of the 'mammalian brain'. This happened 100 million years ago. This area of the brain is also known as the limbic or emotional brain. It allows all mammals to feel emotions and feelings that influence every thought and action, every second of our lives.

Without a limbic brain, we would be bereft of the capacity to love and feel loved, and the gift of emotions. Having a limbic brain is integral to forming and staying in relationships – something that's certainly to our evolutionary advantage.

The limbic brain has a huge influence on other parts of the brain; it is involved in every brain process. The limbic brain, and the emotions and feelings it gives rise to, are more influential in every thought and action than the more recently evolved thinking brain. This is hugely important – feelings are central to all we do and think, and most of time their effect on us is outside of our conscious awareness.

Thinking Monkey or 'rational' brain The latest phase in the evolution of the brain has been the development of the neocortex, or 'rational' brain. It's also known as the higher brain or the frontal

lobes. It allows us to think, talk and discuss our ideas, and to recognise and reflect on our feelings, and make informed choices. The size of the neocortex in humans far exceeds that of other mammals, setting us apart in our ability to reason, communicate and speculate.

Why this evolutionary story is important for your baby

The cells of your baby's neocortex – that part of the brain that allows rational thought - are all present at birth, but this brain region does not begin to function fully until towards the age of two. Before this time, your baby is driven by her mammalian brain, and interprets her world according to the way she feels emotionally.

Early experiences are part of the most important learning of her life. They are retained in the brain's 'implicit' memory, which is not verbal or conscious, but will inform perception and choices throughout life. What a baby feels during pregnancy and in the first years after birth, really does matter: it affects her brain development, it informs her view of the world, and it shapes her perception of herself.

Hard Wiring and Hebb's Law: How Life Shapes the Brain

Cells that fire together, wire together. So goes the catchy phrase that very well sums up how the brain develops and learn in response to experience. Initially suggested by psychologist Donald Hebb not long after the close of World War II, this theory suggests that the more often certain cells fire together, the more likely they are to fire together again in the future. There is no actual wire network – as each event in the brain is an interchange of electrical impulses and chemical exchanges between cells – but cells do learn and they do always operate as a community.

Hebb's theory applies as much to learning to talk and walk as it does to learning to love and feel loved. In every part of the brain, from the reptilian area that helps us regulate hunger, satiation and digestion, to the limbic brain that helps us express and mediate anger, and to the neo-cortex which enables us to remember names, telephone numbers and complex theories, 'hard-wiring' is at work.

Every human has a huge number of neurones. As babies, we are born with many billions. While some are genetically geared to fire together and wire with one another from birth (like cells enabling us to focus on faces above all other visual stimuli) the majority will only fire together when they learn how to do so; and the learning comes from experience.

Cells that are not called into use actually atrophy and die: this follows a principle of 'use it or lose it'. By the age of three, your baby will have formed billions of networks and will also have lost millions of unused brain cells.

Each experience encourages:

- Growth of axons (which send and receive signals between neurones) between related brain cells, or neurones
- Establishment of new and more extensive connections across the synapses (spaces) between neurones

- Increased growth of myelin (a fatty substance) that increases speed of conduction between neurones, facilitating communication
- Modification of the density and sensitivity of receptors on the membranes of neurones, making them more receptive to familiar chemical messages
- Dying or pruning of neurons and synaptic links through lack of use or through trauma / toxic conditions (e.g. chronic stress)

Your influence on your baby's brain development

The neural networking in your child's brain is partly and minimally decided in her genes before birth: but it depends more heavily on the experiences she has in her relationship with you and the other people and events in her life. Development is most intense in pregnancy and in the early years. The way babies are nurtured by parents can promote or undermine balanced development.

Ideally, the different regions of the brain will function well together, and a baby will grow with an appropriate response to fear and danger, an ability to love and behave with compassion, and the skill to recognise and respond to her feelings and the feelings in other people. Repetition of favourable experiences will encourage hard wiring that inclines a person towards emotional stability.

But development may not be balanced. A child whose feelings are not acknowledged or reflected to them, or does not feel a secure and loving bond, may not have the necessary nurturing to develop neural links between the emotional (limbic) area of the brain and the rational (neocortex) region. The potential for neural networking in the brain that allows rational thoughts to link with feelings is cut short – in other words, the ability to make sense of feelings is missing. A child with such experience is likely to become over-rational and may find it difficult to form friendships and to trust.

Another example is a child who repeatedly feels afraid; this child's brain may be highly activated in the reptilian systems, to following primitive impulses of defence and attack that are not mediated by the limbic brain, nor tempered by rational thought. This child may grow to be more than usually inclined towards anxiety or fear, and again find it hard to form friendships.

Emotional attraction – limbic resonance

Limbic resonance is a phrase used to describe the emotional effect we have on each other. Each one of us resonates with the person or people around us, and our moods are literally infectious. We've all seen it – one person smiles, the other does too; at a toddler group, if one baby starts crying, others follow.

What's going on? The process involves signals picked up by the brain, outside our conscious awareness, interpreted, and then used to direct behavior. These signals include facial expression, tone of voice, body movements, the wordless messages passed through eye contact and even very subtle signs such as body aroma.

Limbic resonance with a parent is one of the most important factors in a baby's life. Your love, acceptance and willingness to be there with your baby, your honesty, care and playfulness, will all

contribute to harmonious resonance and optimal development of your baby's limbic brain. And because the limbic brain is fundamentally involved in every millisecond of every day, it's optimal development underpins health, in the short and long term.

There's no doubt that babies need loving carers if they are to develop well. Experiments have been carried out with monkeys who fail to thrive if separated from their mum. More tragic experiments involving human babies have also been conducted, with disastrous results. (See our section on skin-to-skin touch).

Although society's pressure is often to follow reason above our hearts, and to achieve rather than to attach, neuroscience is showing very clearly that listening to our limbic signals - our feelings - and to celebrate them in our babies, is a valuable source of fun, loving and guidance through life.

Learning to love

The mechanisms that encourage some cells to fire together, and others to be pruned, mean that for each individual baby a completely unique brain map evolves. The structure and the function of any individual's brain will be influenced by that person's experience – and this is rooted in what that person feels, especially in relationship with other people.

After the early phase of development, although the brain always retains an element of flexibility, established neural networks tend to be followed. Experience wires the brain, and determines behavior because the brain likes to seek out things that are familiar: what the brain has experienced actually determines what it is likely to experience in the future.

What this means for your baby, on an emotional level, is that the lessons she learns about emotional feelings and how love feels in close relationships will be applied by her brain through life. Within the networking of her brain, emotional attractors form – so without ever intending it to happen, she will attract similar relationships, triggering similar feelings, as she goes through life. The way she feels in relationship with a parent – in her first meaningful relationship – offers a kind of blueprint for the way relationships 'should' feel, and is likely to be repeated. Later in life, change is possible when the feelings are brought to conscious awareness; then patterns can be changed.

The message is very simple: children who feel loved and safe in the womb and in their earliest relationships after birth and feel encouraged to express themselves, are likely to attract and experience more relationships like this through life. The early days are a golden opportunity for parents – you are, in many ways, the architects of your baby's brain.

For more, please come to one of our courses.