Head, Shoulders, Knees and Toes: the drive to walk

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The first year of life is unlike any other stage in human physical development. In a relatively short period of time, the baby changes from a helpless individual to a walking toddler. Parents never forget their baby's first steps. It is a momentous achievement! At that moment, the baby becomes a toddler and a whole new world of learning opens up.

Walking is a complicated process, which requires many mechanical and neurological adaptations to the body and brain. This article uncovers the extraordinary processes which babies undergo before learning to walk. Perhaps the most astonishing phenomenon of all is the 'Walking' reflex, which is thought to be a template for later walking. Exactly why humans walk upright remains an enigma, but some scientists believe it to be an evolutionary response to changing environmental conditions during the transition from ape to hominid.

Most scientists agree that genetic inheritance, the environment, quality of care and exercise and nutrition determine when babies take their first steps. There is also plenty of evidence to suggest that walking development varies according to the culture in which a baby is brought up. Although early walking does not mean that babies are more intelligent than their non-walking peers, there is a link between motor co-ordination and mental ability, which is very different.

A template for walking

Ultrasound scans reveal that the foetus practises walking behaviour from an early stage in development. Such activity stimulates the motor cortex of the brain and begins the process of muscle building that will lead to later walking.

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The most astonishing phenomenon is the stepping or walking reflex. If held under the arms in an upright position, the newborn automatically makes co-ordinated walking movements across a flat surface. Practising the reflex in early infancy may set up a template for later walking. The memory may be called upon later to guide baby's first steps when the leg muscles are strong enough to bear weight. Although the reflex usually fades within a few weeks, older babies may step or walk when partially submerged in water. Experience can also play a role in the in the development of the walking reflex, which may continue until the emergence of unsupported walking. In some cultures such as the Kipsigis tribe from Kenya, early walking is highly valued and stepping is regularly practised. However, there is no evidence to suggest that early walking increases intelligence. In practice, early walkers may be behind in mastering skills such as crawling, which stimulates both sides of the brain and lays the foundations for later reading and writing.

Principles of walking

Two principles govern the acquisition of muscle development and co-ordination in human infants. Firstly, development proceeds from head to toe; from the neck, then the upper body, then the lower trunk, and then the legs. Thus head control emerges before sitting and walking is the last to develop. Secondly, development proceeds from the centre of the body outwards; from the arms to the hands and then from the hands to the fingers. These developments go together with the growth of the brain pathways that become increasingly specialised in movement control.

Head

Head control is the first and most important developmental milestone. Unlike many other newborn animals that can support their heads within minutes of birth, the neck muscles of the human baby are not yet strong enough to support the weight of the large brain. The process depends on muscle action and

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complex connections between neurons in the motor cortex, which increase rapidly within the first few weeks of life.

Shoulders

The strong drive to learn compels the infant to lift and turn the head to see what is going on. Babies that are placed on their tummies when active and alert often achieve head and neck control sooner than those who are used to lying on their backs. Head control and upper body strength can take longer to develop in babies that spend long periods of time in car seats or baby rockers. However, the drive to acquire motor co-ordination is relentless and most babies will discover a whole range of other movements such as twisting and reaching to get what they want.

Rolling over is the next important developmental step. Through repeated practice, the baby can now get to objects beyond arm's reach. However, one of the trickiest things that babies have to learn is how to sit up. There's plenty of room for error here! Babies often wobble for several seconds before they correct their centre of balance.

Sitting up is a major developmental milestone in terms of physical and intellectual development. The baby's visual range expands significantly and the hands are now free to explore the world. From now on, development moves forward at a rapid pace. As soon as one skill is mastered, it is usually pushed aside and a new challenge taken on.

Knees

Some babies may go on to bottom shuffling, spider or belly-crawling, but in terms of efficiency, stability and co-ordination, there is no other movement activity that can match crawling. Babies that miss out the crawling stage may encounter learning problems in school, no matter how intelligent they are.

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However, because crawling is such an important step both physically and intellectually, it is explored more fully in a later article.

Toes

Many animals are able to pull themselves up on their back legs, but in order to move, they have to come back down on all fours. In contrast, babies are designed to walk, once they have discovered how to stand up. It is thought that the drive to walk may be the result of the limitations placed on the use of the hands. It is very difficult to carry something in a sitting or crawling position. Standing on two legs opens up a whole new world of opportunity. However, it is still a long way from bipedal walking. The baby will only be able to stand up unaided when the two little legs are strong enough to support two-thirds of the total body weight. This requires a lot of muscle power, co-ordination, mental determination and practise!

The origin of walking

The question of why we walk on two legs presents a tantalizing enigma to scientists. Although evidence from the fossil record suggests that our ancestors became bipeds on dry land, an alternate possibility is that a watery environment forced them to stand upright. From what we understand from the fossil record and genetics, the process of becoming upright involved modifications to the skeleton and musculature; the consequence of many changes to many genes, over a long period of time.

The most widely held theory suggests that as the African landscape shifted gradually from dense forests to grassland, our ancestors were forced to descend from the trees in order to find food on the ground. At first, it seemed likely that they fed from low hanging fruits and berries and that these were eaten in a squatting position. Over time, changes in the backbones and pelvic areas shifted the centre of balance to a lower point in the body. As our

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ancestors reached higher for food, a vertical stance was adopted. Some anthropologists believe that an upright posture enabled them to carry greater quantities of food - a tricky task for quadrupeds!

It has also been postulated that our ancestors went through a semi-aquatic stage in evolution and that they were forced to walk on two legs in order to keep their heads above water. The theory claims that humans share rare or even unique features that are widespread among aquatic animals, which can only be explained by life in a watery environment. Features include loss of body hair and a high proportion of white fat under the skin, which provides insulation and buoyancy in water. Also, the building of brain tissue and eye function is dependent on an adequate supply of Omega-3 fatty acids, which are abundant in the marine food chain, but relatively scarce on land. Although an aquatic hypothesis offers a far simpler explanation for bipedalism, there have been objections to the theory since its inception and there still are.

An evolutionary link?

The fascinating BBC Two documentary about a Kurdish family in southern Turkey, in which five of the eleven children walked on all fours, generated great excitement among scientists. Turkish scientist Uner Tan, who made the discovery, suggested that studying the hand walkers could shed light on human prehistory. However, many scientists disagreed with his conclusions.

It was suggested that a missing gene on chromosome 17 had allowed some superficial resemblance to a distant ancestor to appear. However, scientists have discovered that the collective actions of many genes are responsible for walking. In the case of the affected individuals, it appeared that the genes responsible for walking were being used in a different way and were not some sort of throwback to an ancestor. The most likely cause for the hand walking behaviour appeared to be underdevelopment of the cerebellum, an inherited

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condition, which subsequently affected movement and balance in these individuals.

Nature or nurture?

Scientists agree that genetics play an important role in physical development, but that environmental factors may also be important. As was seen in the film, if given the opportunity, and with some assistance, the siblings could walk. In a busy family (originally 19), it may have been impossible to provide opportunities for play and exercise at an early age. Exercise is especially important for the development of the brain, which grows in size and complexity throughout the first year of life. Some researchers believe the way in which babies are played with also provides a strong nurture component to walking.

The normal range for walking is very broad. Some babies walk as early as eight months and others as late as two years: most take their first steps towards the end of the first year. Premature babies generally walk later than full term babies of the same age. The skill is usually achieved at the age they would have been, had they been born at term, and sometimes later. Some babies have their own timetable, which cannot be rushed.

The drive to walk

The drive to walk is very powerful and part of an evolutionary fine-tuning process that has been passed from generation to generation over a long period of time. Unless there is some anatomical, nutritional or physiological problem, babies go to extraordinary lengths to achieve this skill. However, there will always be variations between individual babies. No two babies are the same.

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Ways to encourage walking

- Kneel down and hold out your hands to encourage baby to walk towards you.
- Remove baby's shoes - going barefoot improves balance and coordination, builds arches, strengthen ankles and makes the muscles work harder.
- Help baby walk over sand and grass and up and down slopes to develop muscle strength in the feet and legs.
- Provide a toddler truck – it's a great aid to walking!
- Encourage baby to climb on and off the furniture. Besides being fun, it co-ordinates and strengthens the muscles in preparation for walking.

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