



# How infants and toddlers develop movement skills



ECE resources

Learning to move their bodies from place to place and to complete desired ends is one of infants' and toddlers' greatest achievements, and one that brings them much satisfaction and delight. They can use their mobility to explore objects and environments, and to develop social interactions and relationships. As movement skills develop, so do a range of new opportunities for learning.

## What is involved in learning to move?

Learning to move is an enormous task involving the coordination of cognition and perception as well as motor skill. Infants have to conquer gravity, balance and propulsion. Navigating through a busy environment means that infants and toddlers need to adjust their movements step by step, using perceptual information to determine changing constraints on their balance and locomotion, and higher-level cognitive processes for solving problems such as overcoming obstacles. Infants also need to be able to spot affordances for movement in their environments and match these to their physical competencies. Movement may be more or less achievable across a space depending on the distance, gradient, texture and obstacles.

Ongoing changes in children's bodies, skills and environments make the process of learning to move more difficult. Even a subtle change like wearing a nappy or a change in floor surface can support or hinder the possibility of movement. In the first two years, an infant's body size nearly quadruples, their height doubles, and their head circumference increases by a third<sup>1</sup>. This growth often occurs in spurts, so, for example, they can wake up between 0.5cm and 1.65 cm taller overnight!<sup>2</sup> As they grow, their bodies change in proportion too: for example, they become less top-heavy. With increased competency, increased height and size come new perspectives on the world and new opportunities for exploration. Infants must constantly modify and update their assessment of their movement competencies and take this updated assessment into account as they move.

Infants also have to cope with their changed perspective and expanded view when, for example, they progress from lying to sitting to crawling. When lying, infants cannot see things far away, but when they learn to sit up, the whole room sweeps into view. When they transition from sitting to crawling, this movement turns their bodies towards the floor, and away from any potential target they were looking at.

Research demonstrates the considerable problem-solving ability and sheer determination of infants as they learn to explore. One study found that, even given impossibly steep slopes and narrow bridges, infants continued to experiment with different postures and strategies until they found a solution<sup>3</sup>. Infants and toddlers may also problem-solve using tools such as bars and handrails, which demonstrates considerable cognitive work on their part – they must recognise that they are not quite proficient enough in their independent movement to achieve a goal, they must perceive and understand how an environmental support might be used, and then they must implement use of the tool which may involve modifying their own movements (for example, turning sideways to move along a holding a handrail). Developments in cognition make a significant contribution to infants' changing motor capabilities.

## How does movement and physical skill develop?

Infants have a huge task ahead of them – they have to learn to control their posture in different positions (such as sitting, crawling, standing). This takes time, and importantly, multiple experiences that allow them to practise and to make and learn from errors. With time and practice, infants gradually put together muscle combinations and patterns of movement that prove to be increasingly successful in helping them to explore and interact with the world.

Physical development and motor skill development begin in the womb, with fetuses moving from the moment they have rudimentary muscles and the neural circuitry to activate them (five to six weeks after conception)<sup>4</sup>. As newborns, infants demonstrate a wide variety of movements, blinking and moving their eyes, rotating their heads, sticking out their tongues, opening and closing their mouths, pursing their lips, arching their backs, flailing their arms and legs, and wiggling their fingers and toes<sup>5</sup>.

Physical development also includes the development of things like vision (directing the eyes and tracking things), showing emotion, talking, and eating. Infants can produce a rich range of facial expressions, beginning with interest, joy, distress and surprise which are present from birth, and becoming more varied over the first year. One-year-olds, for example, can show expressions of disgust at a sour taste and of anger at being restrained. The sounds infants make, including cooing, babbling and speaking words, are produced by motor actions in the face and throat – these are actually some of the most sophisticated motor skills that humans employ. Even breastfeeding involves highly complex motor actions involving different patterns for coordinating the tongue, lips and jaw.

In their first year, infants accomplish a diverse range of movements for mobility, including rolling, bottom-shuffling, belly crawling, crawling on hands and knees, standing, 'cruising' sideways along furniture, and perhaps independent walking. Many child development researchers have catalogued these, representing them as a process of maturation and a progression from immobility to independent walking<sup>6</sup>. However, each of these movement skills requires the development of a different posture. Posture is an incredibly important part of motor development. Even lying on their backs, infants need to cope with gravitational forces in order to perform actions with their head, torso and limbs. Posture is the motor action that helps them to do this, and similarly other actions are not possible without this ability to maintain balance and a stable support base. Looking, for example, requires head and trunk control, while reaching requires the torso muscles to counter-balance the destabilising effect of lifting an arm<sup>7</sup>. A stable trunk is needed for fluid arm movement, so adequate postural control is essential for infants to be able to reach out and grasp objects for exploration.

Infants have to learn postural control in different positions, including lying, sitting, crawling, and standing. Each involves different muscle groups, different skills for balance, a different range of postural sway, different vantage points for surveying the space around them, and different sources of perceptive information<sup>8</sup>. In addition, what infants learn in relation to each posture is not transferrable to a later posture, which means that the development of physical skills cannot be seen as a set of related stages. Infants need experience with each posture in order to calibrate their posture and movement, and, given this experience, they make surprisingly rapid improvements.

The development of postural control begins in infants' necks and then moves down the body, developing next in the upper back, then the lower back and the hips<sup>9</sup>. It seems that infants develop control over the segments of their spine, one vertebra at a time. They progress from being able to hold up their heads when held under the armpits to being able to hold their backs without crumpling when held at the waist. Once they can keep a straight back, they need to develop hip support to avoid their chest toppling on to their knees. Postural control enables them to keep their head balanced over their outstretched legs when

they are sitting, but also helps them to keep their head propped and the chin tucked when lying down. The main postures that infants work through as they develop movement skills are described below.

## Lying on backs and tummies

Lying on the floor is a one of the first positions that enables infants to practise their postural control. Lying either on their backs (supine) or on their tummies (prone), the infant's actions impact their postural control by shifting the infant's centre of mass. The infant must work out how to adjust their body to keep their trunk balanced and stable. Infants need to develop postural control in these positions before they can engage in exploratory actions such as looking or grasping and touching things.

## Reaching

Reaching for things is a movement that emerges from four months of age, but does not become skilful until about eight months<sup>10</sup>. The urge to reach directs infants' head and hands, and they gradually develop the postural control needed to support the function of reaching. Learning to reach for an object involves postural development (being able to hold the body stable while lifting the arm up, which requires strength and coordination) and perceptual skills (relating the position of the object to the position of the hand and being able to guide the hand to the target). The first attempts at reaching are jerky and inefficient, but over time reach becomes straighter and more direct. Arm movements disturb balance as they displace the body's centre of mass so infants need to activate muscles in their trunk to hold themselves stable as they extend their arms out to reach. Reaching engages the whole body, and infants need to learn to reach in different ways depending on whether they are on their backs, on their fronts, or sitting. Infants can also reach with their legs and grasp with their toes.

## Sitting and reaching

Sitting involves lots of movement skill. Learning to sit independently is thought to be a significant factor in children's overall motor skill, and corresponds with changes in perceptual, cognitive and social abilities. For example, children are more able to engage in visual and object exploration. Research shows that, when sitting, the body is continually in motion, swaying forwards and backwards and side to side, so sitting independently requires infants to gain skills in balance, and to coordinate muscles in the neck, trunk, hips and legs. Sitting and reaching supports children to develop coordination of their eyes, head and hands, and is also thought to affect the emergence of crawling and eventually walking<sup>11</sup>.

Infants begin learning to sit around four to five months of age as they develop control of their head and upper trunk. Infants initially sit with support from their arms, and move into briefly sitting without this arm support before they start sitting independently and using their hands for touching and holding objects rather than for supporting their posture. Being vertical through sitting encourages infants to reach for more things, so once infants have mastered sitting, they reach for things more often and more reliably. Two handed reaching in front of the body emerges first before one handed reaching at either side.

Being able to sit independently facilitates new ways of exploring objects, but the processes involved in sitting and reaching for an object are considerable. Infants must work their head, neck and eyes together with the trunk muscles in order to reach an object of interest. Learning to combine sitting and reaching requires infants to problem solve in order to plan and execute their movement for their exploration of an object. For example, they need to think about whether they reach for the object with one or both hands, or whether they inhibit their urge to reach for the object in order to maintain balance. As they develop the ability to reach, they already understand their level of stability and can perceive how reachable the object is. They generally only attempt a reach when they can avoid tipping or losing balance.

Research shows that it is the infant's motivation to reach for objects that drives their development of sitting, even though it disrupts their sitting stability in the process. In fact, infants persevere with reaching even during stages of insecure sitting – research shows that in spite of falling, and in spite of significant movement in their pelvis and trunk affecting their stability, infants persist in reaching and actually increase their reaching attempts<sup>12</sup>. Infants are able to sit straighter and more vertically as they develop, and this improvement in alignment is not separate from the reaching but learnt alongside the reaching behaviours.

Hand control must also develop. Very young infants are unable to hold an object: they either drop it or hold it without adjusting their grip. They may reach for objects with closed fists. As they develop, they learn to keep their hand open and close it after they bump it into the object, before learning to begin to close their fingers during the reach ready to grasp the object. Over their first year, infants increase their skills in adjusting their fingers and thumb for grip and the orientation of their hand in preparation for grasping objects.

Reaching and grasping skills are important as they support infants to explore objects and gather information about their properties. They are also then able to use tools to achieve a range of purposes. Using a tool such as a spoon, for example, requires a range of visual and physical skills, including an appropriate grip, adjusting the angle of the spoon to prevent spilling, holding the arm steady while loading and transporting the food, opening the mouth, and visual monitoring. Similarly, using a hammer requires an appropriate grip and positioning of the hand on the handle, controlling an up and down movement, orienting the hammer head downwards, and aiming at the target.

## Becoming mobile

Becoming mobile is a major achievement which offers infants new opportunities to explore their environment. Research shows that many of children's bursts of locomotion are not aimed at reaching a destination, person, or thing. Only half of crawlers' movement bouts end at destinations, and less than one third of walkers<sup>13</sup>. Instead, it seems that infants move around without any particular destination in mind in order to generate information about the body and their environment. It also appears that they simply find movement itself pleasurable.

## Rolling and pivoting

Infants begin to move their bodies in space through the actions of rolling and pivoting. Rolling involves flipping from front to back and vice versa, while pivoting involves rotating the body in circles along the floor. These movements are made in order to help infants orient their bodies better or to gain a better vantage point in regard to nearby objects, people and events. Rolling is random at first, and pivoting happens very slowly and incrementally, but eventually infants start to use these movements for more intentional reorientation in the space.

## Crawling

Crawling on hands and knees is a complex physical skill as it uses new patterns of coordination of different body parts. It does not always initially involve moving on hands and knees, and there are a variety of ways in which infants may solve the problem of getting around. Some may move in a sitting position by hitching with one leg, or shuffle on their bottoms. Some may belly crawl, or crawl on hands and feet, or crawl with knees to their tummies. Infants need to practise executing the variety of movements possible in previous postures as this has beneficial effects on the movements for crawling on hands and knees<sup>14</sup>.

## Walking

Getting the body into an upright position is a process that takes many months. At about 7 months of age, infants begin standing while holding on to furniture to support themselves. They control their balance with their arms at first, and stand on their toes or on the outside edges of their feet before learning to stand flat-footed and bear their weight more squarely across their feet. Then they learn to pull themselves to a standing position, and to 'cruise' along furniture, moving sideways and lifting their arms and legs one at a time. Cruising requires infants to notice and take advantage of affordances in their environment, and they are usually fairly adept at finding furniture and equipment to support this venture!

To stand without support, infants need to actively control their balance. They use multiple sources of perceptual information including information from the stretching of the skin on their feet, information from the muscles and joints in their legs, and visual information. They need to develop sufficient balance and strength to stand on one leg while the other moves through the air in order to take their first walking steps. Infants' changing bodies are helpful in the development of walking. They develop more muscle relative to fat in the legs, and their body proportions slim down, making their centre of mass lower and decreasing destabilising forces. At this stage infants also develop new brain structures and neural circuitry that enable greater control over alternating leg movements.

It takes four to six months of independent walking before walking becomes more uniform and consistent<sup>15</sup>. When this happens, infants are no longer responding ad hoc to the outcome of each step, but walk in a more uniform manner with longer steps and feet closer together. They also walk faster, with less time with both feet on the ground.

## What is the teacher's role in supporting movement?

For optimal physical development, of the most important things that children need is time. They also need repeated opportunities to practise various movements in every postural position over a range of activities involving balance and movement<sup>16</sup>, and over diverse ground surfaces varying in friction, texture and rigidity. Infants require a considerable amount of practice for learning to move. One estimate suggests that, in an hour, 14-month-olds take more than 2000 walking steps, cover a distance of approximately seven football fields, and experience around 15 minor stumbles or falls! Children are developing movement skills all the time, including while they are interacting with people and objects. Competency in the later stages of movement development relies on infants having sufficient practice in the earlier stages. For example, the amount of time that infants spend practising earlier movement skills such as lying, sitting and reaching predicts their later proficiency at crawling on hands and knees.

It is important to be aware of different cultural expectations and childrearing practices which can have an impact on motor skill development. Some families may engage in practices for deliberately supporting or even training physical development, such as daily massage and exercise routines that involve stretching and stroking infants, or even simply 'walking' infants while holding their hands. Special seats or objects used to prop infants into sitting positions might be used too, although the research on their use is mixed. In these contexts, infants often achieve physical milestones at earlier ages than their same-age peers<sup>17</sup>.

While it is important to honour family aspirations, explicit instruction and training are unlikely to be helpful for physical development. Research finds that explicit instruction in how to move has limitations. For example, when infants are taught the backing strategy for negotiating a particular stairway or set of steps, they tend not to transfer this skill to a new staircase or steps<sup>18</sup>. Researchers also argue that while infants can engage in more hands-on, visual and oral exploration of objects when they are sitting<sup>19</sup>, this does not necessarily mean that children's posture should be supported by cushion-propping or specially designed seats. Supporting sitting can lead to short-term advantages, but there is no evidence of long-

term cognitive or social gain for training children in postural control, and there is no reason to suggest that advancing these skills is advantageous in terms of aiding children's exploration<sup>20</sup>. Research shows that instability and making errors are an important part of the learning process, and seem to contribute to motor skill development success<sup>21</sup>. Children may not need, nor benefit from, special support.

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## Further reading

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## Endnotes

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7 Adolph & Berger, 2011.

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10 Harbourne, R. T., Lobo, M. A., Karst, G. M., & Galloway J. C. (2013). Sit happens: Does sitting development perturb reaching development, or vice versa? *Infant Behavior & Development*, 36, 438–450.

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13 Hoch, J. E., Rachwani, J., & Adolph, K. E. (2020). Where infants go: Real-time dynamics of locomotor exploration in crawling and walking infants. *Child Development*, 91(3), 1001–1020

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