

Locomotor Development

Marin, L., Weise, I., & Adolph, K. E. (in press). Locomotor development. In L. Balter (Ed.), *Parenthood in America: An Encyclopedia*. Denver, CO: ABC-CLIO.

Locomotor Development refers to changes in children's mastery of mobility. The developmental progression begins with spontaneous arm and leg movements during the fetal and newborn periods, followed by rolling, crawling and other idiosyncratic forms of prone progression midway through the first year, then pulling to a stand and balancing upright, then walking at the end of the first year, and finally, running, jumping, and more sophisticated forms of mobility during the second year. For nearly 100 years, the popular belief was that locomotor development is a chronological and hierarchical process: each stage builds on the previous one in a strict and orderly march toward erect locomotion. However, researchers now believe that normative data (milestone charts that tell when the “typical baby” achieves each milestone) may not accurately reflect individual infants. In fact, the order and appearance of each form of locomotion stems from parents’ child-rearing practices unique to each culture, infants’ body proportions and muscle strength, and their temperament and motivation to go somewhere.

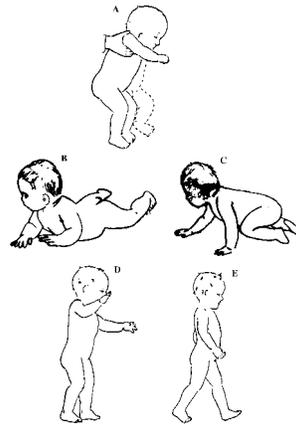


Figure 1: When held under the arms in an upright position, newborns spontaneously move their legs in an alternating pattern—the stepping reflex (picture A). Most Western babies crawl at some point before they begin walking. In picture B and C, we can see two typical crawling styles: belly crawling and Hands/knees crawling. Finally, new walkers’ Charlie Chaplin style (D) progressively improves so that by the time children reach seven years of age they walk like adults (E).

The earliest precursors of locomotion are the spontaneous arm flails and leg kicks of babies in the womb. Such fetal movements may be masked at the end of gestation because babies’ limbs are so tightly packed into the womb. After infants are born, again they display spontaneous rhythmic arm and leg movements. They make these movements when they are lying on their back, awake and aroused, but without any noticeable prompt. Flailing and kicking movements are important for development because they help to build and strengthen muscles necessary for later locomotion and they provide a way for infants to discover the limits of their body space. However, infants are still a long way from achieving true mobility.

Everyone knows that newborn babies can’t walk. There are two biomechanical reasons for this. First, infants’ leg muscles are too weak relative to their leg fat for them to lift one leg while supporting the body’s weight on the other leg. Second, newborns can’t keep balance in an upright position. They don’t yet use stimulation from their visual system, inner ear, and muscle senses to control balance. Furthermore, the problem of keeping balance is exacerbated by infants’ top-heavy body proportions. With more weight in their head and chest, newborns have a higher center of gravity and, like a top-heavy bookcase, are prone to tipping. Surprisingly, when constraints of muscle strength and balance control are eliminated, newborns can do something that looks like walking. When held under the arms in an upright position, newborns spontaneously move their legs in an alternating pattern—the stepping reflex. A few months later, when babies’ legs are too fat for them to march along the table top, the stifled alternating leg movements reappear when they are held over a motorized treadmill. In both cases, the adult provides the missing balance control and leg strength by holding infants upright and by partially supporting their body weight. In addition, the treadmill compensates for leg strength by stretching one leg backward and allowing it to pop forward like a spring. However, in newborn stepping and treadmill walking, the adult does not provide a key ingredient of real walking—the motivation to go somewhere.

Prelocomotor infants experience displacement of their bodies when their caregivers carry them from place to place. Such passive movements provide visual stimulation and activation of the vestibular system of the inner ear. Although babies enjoy being carried and often look out at the world, there is no evidence that infants learn about balance control or places to go from passive locomotion. Once babies achieve independent mobility and travel from place to place on their own, they begin to actively explore their environment. Now they can go see what is around the corner or behind the door. They can learn about surfaces, places, and paths between them, and they can discover various methods of locomotion for going somewhere. Independent locomotion is certainly important for babies, but also for parents who view infants' first steps as a marker of emotional independence and maturity.

Self-initiated locomotion often begins with idiosyncratic solutions. Some babies begin moving long distances by rolling, others by bum-shuffling in a sitting position, others by pushing backwards in a prone position, and still others by lying on their backs and arching like a wrestler. Most babies, however, discover some form of prone progression. The crawling posture is not rigidly structured; there are at least twenty five different kinds of crawls and creeps documented in the literature. Approximately half of crawlers begin by dragging themselves forward with their abdomen on the ground in some form of belly crawling. These babies later crawl on hands and knees with their abdomen suspended in the air. The other half of crawlers skip the belly crawling period completely and go straight to hands and knees. Belly crawlers tend to move their arms and legs in a variety of combinations and permutations, even from cycle to cycle. Hands/knees crawlers, in contrast, all move their limbs in a trotting pattern with limbs on diagonal sides of the body moving together. Some hands/knees crawlers also discover that they can move forward on hands and feet.

Most Western babies (around 85 percent) crawl at some point before they begin walking. There are exceptions to this rule, however. Cultural expectations and practices, as well as a babies' individual skills and temperament will influence whether they will crawl and the type of crawling strategy they will select. For example, in the Bombara culture of Mali, babies rarely crawl before walking. They are jounced up and down in a sling by their mother's side, exposed to rigorous exercise and massage during daily baths, and are rarely put them down in a prone position. In contrast to crawling which is not obligatory, in all documented instances, infants experience some sort of upright skills prior to independent walking. For example, babies pull to a stand, let go and balance, "cruise" sideways holding onto a couch or low table for support, walk frontward pushing a cart, or walk frontward holding a caregiver's hands. In this transitional stage, to locomote without falling over, infants require some sort of manual support.

Independent walking is heralded by parents as the most exciting and important stage in locomotor development. It typically appears around twelve months but varies widely between individual babies. Because walking only involves two limbs over a smaller base of support, it requires more balance control than crawling or cruising. Unlike crawling, the body is far away from the floor, and unlike cruising a walking infant does not use any manual support. Although minor falls and tumbles are experienced by all new walkers, walking is more risky than crawling or cruising because walking mistakes can have more serious consequences. Beginning walkers have a long way to go before they become proficient masters of their newly acquired skill. There is a dramatic change in walking gait from babies' first steps to the toddler years and beyond. New walkers take small steps with their feet spread wide apart. They walk on their toes or plant their whole foot down rather than walking in a heel-toe progression like adults. Like Charlie Chaplin, some babies keep their toes pointed outward and their legs almost straight with their elbows bent upward and their palms facing the ceiling. Others charge along headlong with toes pointed straight ahead and swinging their arms wildly. New walkers' gait appears drunken because they lack coordination between arms and legs, and they must recover balance from step to step as they weave and lurch along. This strange and funny walk progressively improves so that by the time children reach seven years of age they walk like adults. The rate of walking improvement is exponential but varies across individual babies.

Walking is certainly not the final stage of locomotor development. In the second year of life, toddlers acquire other locomotor skills such as running, jumping, turning, walking backwards and walking up and down stairs while holding a rail. As their environments expand, they discover innovative strategies for locomoting down hills, over and under barriers, and over varied terrain. As they become more social, they use locomotion playfully to dance and to learn athletic skills. While locomotor milestones (balancing, sitting, crawling, and walking) develop most rapidly in the first two years of life, the development of locomotor skills never actually stops. From manual tasks that require fine motor coordination to learning how to play a new sport, we are constantly faced with new tasks that require new locomotor abilities.