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Step Reflex



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Synonyms

Inborn reflex; Innate reflex; Instinctive reflex;
Physiological reaction; Primitive reflex; Reflex
action; Stepping reflex; Unconditioned reflex;
Walking reflex

Definition

The step reflex is the automatic alternating limb movement response to the stimulus of feet or paws touching a firm surface.

The step reflex, also called the walking reflex, is the automatic alternating limb movement response to the stimulus of feet or paws touching a firm surface. The step reflex is a primitive reflex present in some altricial-limbed vertebrates, and it assists with the development of locomotion ability. In typical development, the step reflex emerges in utero, is present at birth, and disappears in early development. The step reflex has primarily been studied in humans, although there is evidence of this reflex in other species such as cats and rats (Muir 2000).

Locomotion is vital for many organisms to solve many adaptive problems, including acquiring nutrients and escaping predation. Locomotion likely played a significant role in the evolution of a myriad of species, and the step reflex is crucial to the development of movement abilities in some altricial mammals. Altricial and precocial vertebrate nervous systems share the basic circuitry for locomotion, demonstrating that similarities have been preserved throughout vertebrate evolutionary history (Muir 2000). One of the most pronounced differences between altricial and precocial vertebrate locomotion is the developmental delay in movement ability in altricial species. Precocial species are able to locomote voluntarily at birth, thus requiring less parental care, whereas altricial species cannot locomote independently and require more extensive parental care for survival. The mechanisms that activate spinal cord circuitry causing alternating steps or swimming are present in vertebrates at birth; however, brain development in altricial vertebrates is delayed and, therefore, altricial infants require a reflexive response to stimulate the alternating limb movements characteristic of walking, whereas precocial infants are able to locomote voluntarily (Muir 2000).

Humans are a highly altricial species that exhibit the step reflex. The step reflex is organized at the level of the brainstem, whereas crawling and walking require the involvement of the cerebellum and the cerebral cortex (Kolb and Wishaw 2003). In an adult human, the cerebellum assists

with balance, the prefrontal cortex plans movement, the premotor cortex organizes the sequence of movements, and the motor cortex executes the action (Kolb and Wishaw 2003). Humans are born before cerebellar white matter has undergone the most rapid and dramatic period of myelination and before the cerebral cortex is fully developed, so the infant brain is not equipped to control movement as an adult brain does (Kinney and Volpe 2018). As neurological development progresses, at about 2 months after birth, the step reflex disappears and other brain regions take over control of functions related to stepping and locomotion (Yang et al. 1998).

Cats and rats are quadruped altricial species that demonstrate evidence of the step reflex. Robinson and Goldberger (1986) found that kittens less than 2 weeks old that have undergone complete transection of the spinal cord can walk on a treadmill without training while adult cats struggle with motor function after spinal cord transection. It is possible that newborn kittens demonstrate the step reflex in their relatively superior walking ability after spinal cord transection whereas adult cats have already developed the neural pathways that inhibit the step reflex and are therefore unable to recover as quickly. Kittens that underwent this surgery expressed motor control typically not seen until later in development in normal cats, suggesting that this behavior is normally suppressed and may be the result of latent genetic architecture (Robinson and Goldberger 1986). In rats, spinal pattern generators for locomotion are present in utero although rats do not locomote until around 11 days after birth (Westerga and Gramsbergen 1990). Rats are born at a relatively immature stage, demonstrating altriciality in their inability to move about freely at birth. Nguyen et al. (2017) found that when rat pups are held in the air with their hind paws touching a flat and firm surface, at 4 days postnatal, they will reflexively perform a motion similar to walking despite an inability to walk independently. More research is necessary to confirm the presence of step reflex in nonhuman animals.

Cross-References

- ▶ Altricial
- ▶ Bipedalism
- ▶ Catarrhine Locomotion
- ▶ Cerebellum
- ▶ Feline Locomotion
- ▶ Grasping Reflex
- ▶ Hominid
- ▶ Hominoidea Locomotion
- ▶ *Homo sapiens*
- ▶ Innate Behaviors
- ▶ Locomotion
- ▶ Mammalia
- ▶ Movement/Locomotion
- ▶ Myelination
- ▶ Natural Selection
- ▶ Nervous System
- ▶ Precocial
- ▶ Primate Locomotion
- ▶ Quadrupedal
- ▶ Reflex
- ▶ Rodentia Locomotion
- ▶ Species
- ▶ Vertebrate Nervous Systems

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