Characteristics of Complex Motor Skills

Part III: Gait, Bimanual Control, & Haptic Perception
Gait

People put too much emphasis on the emergence of upright independent walking.

People assume that if the child walks sooner, he or she is advanced in their motor development. This notion has not been proven.

Let’s examine the stages one take in developing an upright independent walk and various related motor control issues.
Development of the Upright Independent Gait

First we need to remember that we develop cephalocaudally.

We need to first understand the acquisition of voluntary head movements.

During the first month of life we virtually have no voluntary control over the head or neck (So when you pick up a newly born child support their shoulder, neck and head.)

At around 5 months the child has relatively good muscular control over their neck and head.

At 5 months the child can raise their head when in the supine position (lying on one’s back).

Control of the head enables infants to scan their surroundings.
Development of the Upright Independent Gait

Once the child has the ability to elevate their chest and head, the child has gained some control of their arms, hands, and fingers.

Once the chest can be elevated the child will attempt to roll from a supine position to a prone position. This is important because it enables the child to attain a proper position for crawling.
Development of the Upright Independent Gait

Upright independent sitting is an important milestone. It frees the hands so the child can reach, grasp, and release objects.

For early sitting to occur one must support the lower back and abdomen.

By 5 months the lumbar control has stabilized and the child can hold an external object.

By 8 months the child has gained sufficient movement ability to set independently without assistance.
Development of the Upright Independent Gait

Self-support sitting is associated with eye-hand coordination (Rohart, 1992).

Upright posture will follow self-support sitting. Following skills will then emerge:

- ability to pull their body from a sitting to standing position
- period of experimental standing with the aid of external objects such as a chair or furniture
- Standing position will be characterized with a high arm carriage and wide base of support.
Being able to position the body so one can move from one location to another occurs in a predictable progression:

First Crawling
- emerges around 7 to 8 months of age
- involves thrusting the arms forward and then flexing so they drag their body along the surface

Then Creeping
- is elevated crawling with the only the arms and knees.
- contralateral (limbs in opposition) or homolateral (limbs on the same side moving in the direction).
Development of the Upright Independent Gait

When the child begins to walk:
- the arms have a high carriage
- very wide base of support
- knees are in the flexed position
- toes pointed out
- length of strides are highly inconsistent.
- lateral stability is poor
Motor Control of Upright Independent Gait

Central pattern generators in the spinal cord control human gait.

Decerebrated cats (severing the spinal cord from the brain) can perform locomotor rhythmic muscular activity (Sherrington, 1906).

The rhythmic structure of gait patterns enables researchers to understand the involvement of CNS with musculoskeletal dynamics.
Motor Control of Upright Independent Gait

There is a distinct rhythmic relationship that exists:
For the legs in step cycle, in walking, and in running.
Between the arm movements and legs that relates to walking speed.
- 2:1 ratio (two arms swing to each leg stride) exists for slow walking
- 1:1 ratio exists for fast walking

Knowing that distinct rhythmic relationship exist is important in measuring coordination problem.
Motor Control of Upright Independent Gait

Head stability is key factor of the Gait.

The head contains the sensory and motor nervous system components that helps us navigate through an environment and in maintaining one posture.

Maintaining a stable head during locomotion optimizes the use of vision so we can tracking a ball, catch an object, and avoiding objects.

Adults with neurological impairment adopt an abnormal posture and gait as a means to maintain head stability (Holt, et al., 1995)
Motor Control of Upright Independent Gait

Walk to run or run to walk transitions occur at different speeds.

These changes are spontaneous transitions but they vary between people. Why?

It is not due to physical limitations. The spontaneous transition occurs at a speed where we minimize metabolic energy consumption (VO2).

This assumption has not been totally supported but spontaneous transition remains a puzzle for researchers to solve.
Bimanual Control

Bimanual movements involve the limbs moving in same similar pattern (symmetric) or moving each limb differently (asymmetric).

For example:
- Playing guitar
- Tying a shoe
- Pearson wheelchair rolling
- Drummer
- Serve in tennis
Bimanual Control

Whether we perform symmetric or asymmetric bimanual skills, the two limbs prefer to do the same thing at the same time.

- Rub your stomach with one hand while at the same time tap your head with the other hand. Gradually increase the speed of each action...What happens?
Bimanual Control

Bimanual skills do not apply to Fitt’s law.
- temporally moving both limbs eventually overcame the influence of the speed accuracy trade off relationship

Bimanual skills is where one limb performs a more difficult task while the other performs a easier task. The more difficult task will always influence the less difficult task.
Bimanual Control

Bruner examined bimanual control in infants through early childhood.

- By 4 to 5 months children could only manipulate one toy at a time.
- By 6th month the children reached and grasped two toys.
- By the 9th month, the child can manipulate 3 toys.
- By 18 months, the child is using both hands about 30% of the time.
Bimanual Control

How do we become proficient in performing bimanual skills?

Answer is we learn to uncoupled (dissociate) our limbs and begin moving the limbs asymmetrically.

Uncoupling is a difficult process for people but given proper instruction, feedback, and practice one can become asymmetric.
Haptic Perception

The ability to acquire information about objects with the hands and recognize objects from handling them.

- temperature
- size
- texture
- weight
- shape
Haptic Perception

A consistent pattern of haptic perception development occurs:

1. Temperature and hardness is perceived early during the first six months of life.
2. Texture and weight can be perceived sometime between 6-12 months of age.
3. Shape perception occurs around 12-15 months of age.
Haptic Perception

Emergence of haptic perception appears to be linked to different types of hand movements (exploratory procedures).

Any attempt to inhibit a child’s ability to learn about an object may reduce certain forms of haptic perception.