Motor system development begins during the Prenatal period

- Thalamocortical and Corticothalamic pathways are complete by the beginning of the third trimester (26 weeks)
- Provides the major sensory input and motor output pathway in the brain
- Babies are able to move even before then
POSTNATAL MOTOR DEVELOPMENT

Gesell & Thompson (1934; 1938)

- Comprehensive study of motor development
- Study of over 500 children, detailed assessment of developmental change in posture, balance, reach, locomotion.
General Trajectories

Cephalo-Caudal Development: “Head to tail”
- Control of head and neck before lower torso and feet
- Lift head → sit → walk

Proximal-Distal Development: “Central to peripheral”
- Control of shoulder before hands
- Bat at object → directed reach → grasp

MOTOR DEVELOPMENT

REFLEX:
- An involuntary muscular response to a sensory stimulus.
- Cough, sneeze, blink, yawn, gag

PRIMITIVE REFLEXES:
- Transient set of reflexes evident in the newborn
- They are called primitive because they are controlled by the most primitive parts of the brain, the medulla and midbrain, both of which are almost fully developed at birth

<table>
<thead>
<tr>
<th>Reflex</th>
<th>Description</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sucking</td>
<td>Baby sucks when lower lip is brushed</td>
<td>Fundamental to early feeding</td>
</tr>
<tr>
<td>Rooting</td>
<td>Baby turns head and opens mouth when cheek is touched</td>
<td>Facilitates early feeding</td>
</tr>
<tr>
<td>Grasp</td>
<td>When finger or other object touches baby’s palm, fingers close around it</td>
<td>Maintain contact with parent.</td>
</tr>
<tr>
<td>Moro</td>
<td>If baby drops unexpectedly, or if there is a noise, baby throws arms out,</td>
<td>Possibly a facilitator of early bonding.</td>
</tr>
<tr>
<td></td>
<td>arches back, and then brings arms together and grasps on</td>
<td></td>
</tr>
<tr>
<td>Stepping</td>
<td>When baby is held upright, toes lightly touching surface, makes rhythmic leg</td>
<td>Maybe a component of later walking</td>
</tr>
<tr>
<td>Babinski</td>
<td>When bottom of baby’s foot is stroked, toes fan than curt.</td>
<td>Presence at birth is a sign of normal neurology. In adults is sign of pathology</td>
</tr>
</tbody>
</table>
### MILESTONES OF MOTOR DEVELOPMENT

- Newly acquired skills that are fundamental to skilled performance
- The acquisition of each skill is a landmark in the individual’s motor development

#### POSTURAL CHANGES

#### REACH AND GRASP

#### LOCOMOTION

<table>
<thead>
<tr>
<th>Age</th>
<th>Prone</th>
<th>Sitting</th>
<th>Standing</th>
<th>Eye-Hand</th>
</tr>
</thead>
<tbody>
<tr>
<td>4mo</td>
<td>Flexes. Lifts head momentarily.</td>
<td>When pulled to all, head lags.</td>
<td>Reflexive stepping</td>
<td>Eyes follow to midline. Hands clenched.</td>
</tr>
<tr>
<td>6mo</td>
<td>Head middle. Lifts head.</td>
<td>Head starts righting.</td>
<td>Eyes follow past midline. Regards hand of extended arm.</td>
<td></td>
</tr>
<tr>
<td>15 mo</td>
<td>Creeps well</td>
<td></td>
<td>Makes held by hand.</td>
<td>Cooperates in dressing.</td>
</tr>
</tbody>
</table>
WHAT CHANGES WITH DEVELOPMENT?

Classic theories stressed prescribed maturation – biological change enables behavioral change.

More recent work stresses the interaction of biological development and experience.

Two examples from studies of the “Stepping Reflex”

The stepping reflex is a transient neonatal response that goes away at about 2-months of age.

Infants do not show such “walking” movements again until the end of the first year of life.

Two possibilities:
• The stepping reflex is a developmental anomaly, with little relationship to later walking
• The stepping reflex reflects an early phase in motor development, that gradually becomes elaborated.

Thelen: Developmental change in the “Stepping Reflex”
Early evidence for systematic change.

Used “kinematic” data analysis and Electromyography of the four major muscle groups of the leg to analyze:
• The stepping reflex
• Spontaneous kicking while lying in a supine position.
Results
The leg movements in the two conditions were identical in terms of both the kinematic sequence and engagement of muscle groups:

- Rapid simultaneous flexion of ankle, knee, and hip
- Extension characterized by a swing forward of lower leg and flexion of the ankle
- The timing parameters for the two conditions was very similar.

Results
These findings demonstrate that the “stepping reflex” is part of a more general pattern of motor activity.

But:
- why does the reflex go away
- while spontaneous kicking does not – indeed kicking increases in frequency as reflexive stepping wanes.

Thelen: Developmental change in the “Stepping Reflex”
Early evidence for systematic change.

There is a relationship between the mass of the infants legs and the disappearance of the reflex.

Thelen postulated that as infants legs became heavier their ability to lift them declined

Thus, there are physical constraints on the stepping response.
Thelen: Developmental change in the “Stepping Reflex”
Early evidence for systematic change.

Two tests:
- When infant who no longer showed the stepping reflex were placed in a pool of water, the stepping reflex returned.
- When weights were attached to the legs of infants who still showed the stepping reflex, the children no longer showed the reflexive response.

DOES CHANGE IN MOTOR ABILITY AFFECT OTHER ASPECTS OF DEVELOPMENT?

CAMPOS:
What is the effect of self-locomotor activity on social, cognitive, attentional development?

“Travel broadens the mind”

Studies of Children with Different Early Experiences

GROUPS:
- Pre-locomotor
- Self-locomotor infants
- Walker experienced infants

- Controlled for age (all 8-months)
- Tested on a variety of cognitive, affective and attention tasks.
Cross-cultural Differences in Children’s Early Experiences

Children growing up in urban China:

- Show an average 3.3 month delay in onset of locomotion
- Result of living in constrained contemporary urban apartments
- Infants are placed on a bed surrounded by thick pillows, the bed is soft and does not provide enough resistance to the child’s efforts to push up resulting in delayed development of the upper musculature

Results:

Locomotor experience – but not age – had a significant effect on spatial search performance.

Delays of several months in the development of spatial search performance were observed – these corresponded with duration of delays in onset of locomotor activity.